

Aviation Week

Including Space Technology

USAF Pushes
Minuteman
Silo Test Shots

Atlas-Able IV





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AVIATION CALENDAR

(Continued from page 5)
of Technology, Chicago Section, American Welding Society

Feb. 13-16: Winter Convention on Military Electronics, Institute of Radio Engineers, Willard Hotel, Los Angeles.
Feb. 16-17: 5th Annual Meeting of the American Council on Calibration, Philadelphia, Pa. Sponsored by Institute of Radio Engineers, American Institute of Electrical Engineers, University of Pennsylvania.

Feb. 16-18: National Symposium on Non-destructive Testing, American and Mexican Non-destructive Testing, San Antonio, Tex. Sponsored by American Society for Non-destructive Testing, Southwest Research Institute.

Mar. 18-21: National Propulsion Meeting (sponsored), Institute of the American Society of Metals, Cleveland, Ohio.
Mar. 21-24: International Symposium on High Temperature Materials, University of Chicago, Chicago.
Mar. 22-24: Aerospace Materials and Materials Seminar, Laboratories, Jeppesen-AIAA, National Space Foundation.

Apr. 8-10: Structural Design of Space Vehicles, California Institute of Technology, Pasadena, Calif. Sponsored by American Institute of Aeronautics and Astronautics, University of Southern California, and Materials Committee.

Apr. 6-8-10: National Meeting "Space Transportation-Space Power," Institute of the American Society of Metals, Bethesda, Md.
Apr. 19-21: International Symposium on Aerospace Materials and Feedback Systems, Engineering Societies Bldg., New York, N.Y. Sponsored by Defense Research Board, Department of Defense, Research and Analysis Institute of Radio Engineers.

Apr. 19-21: National Symposium on Manned Space Systems, Institute of the American Society of Metals, Anaheim Hotel, Los Angeles. Sponsored by Congress, National Aerospace and Space Administration, the American Society.

Apr. 21-23: Metal, Metals & Materials Conference "Metals and Materials for the Space Age," American Institute of Mining, Metallurgical and Petroleum Engineers, Anaheim Hotel, Los Angeles.

Apr. 23-25: The Winter Convention and Exposition, American Welding Society, Biltmore Hotel and Grand Central Auditorium, Los Angeles, Calif.

Apr. 27-28: National Meeting on Space Age Materials, Congress Center of the American Society for Metals, Sherman Oaks Hotel, Sherman Oaks, Calif.

May 9-11: Metal Symposium, The Institute of Metal Forming, Professional Group on Macromechanics, Theory and Tech Expert Hotel del Coronado, San Diego, Calif.

May 9-11: Second Southwest Metal Congress and Exposition, American Society for Metals, Sheraton-Dallas Hotel and State Fair Park, Dallas, Tex.

May 16-17: 1960 Materials Conference, Conference, Willard Hotel, Washington, D.C. Sponsored by Institute of Radio Engineers Professional Group on Component Parts, American Institute of Electrical Engineers, Materials Industries Inc., Western Electric Manufacturing Assn.

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AB-12



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HIGH CAPACITY—With an 8-ton payload, Sikorsky's new S-64 turbine-powered crane, will carry three times more than the experimental S-69. It is the first in a new family of Sikorsky turbinescrapers designed to carry up to 40 tons.

TOP VERSATILITY—In restricted areas where even a helicopter cannot land, the S-64 is designed to raise and lower loads on a hoist, as above. Where landings are possible, cargo can be attached by cable to four hard points on the fuselage. The S-64 is designed to handle bulky loads no less than 10 feet high and about 20 feet wide. A variety of passenger and cargo pods, bins and platforms, plus silent vibration-free suspension will make the S-64 a Universal Transport Vehicle of unprecedented versatility and usefulness for military or commercial service.

PROVED DEPENDABILITY—Sikorsky's program of step-by-step progression with thoroughly proved designs and components will assure user dependability. Vital nose assemblies, gearings, controls, and other dynamic components for the S-64 have been proven in years of service in Marine Corps and Army S-65-type helicopters. The entire concept has been tested and demonstrated for many months in the S-66.

FIRST FLIGHT—The first S-64 is programmed for flight in the fall of 1960.

SIKORSKY AIRCRAFT, Stratford, Connecticut
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**Sikorsky S-64
—new 8-ton
payload
turbine-powered
flying crane**

This system test stand module designed by Western Gear for field servicing of Convair F-106 Vari-Duct Drive unit. Features individual performance trait parameter reliability. High pressure hydraulic test at 1520 psi, low pressure at 265 psi, parameter emergency test at 3160 psi. Features built-in safety precautions to prevent unit damage during test and shutdown. Features static, operational, load, stall and running tests, includes concrete and vehicles. Stainless steel piping throughout.



Reliability is assured...



This craftsmanship shown in this sturdy yet simplified design of a complex test module, designed, developed and built by Western Gear.

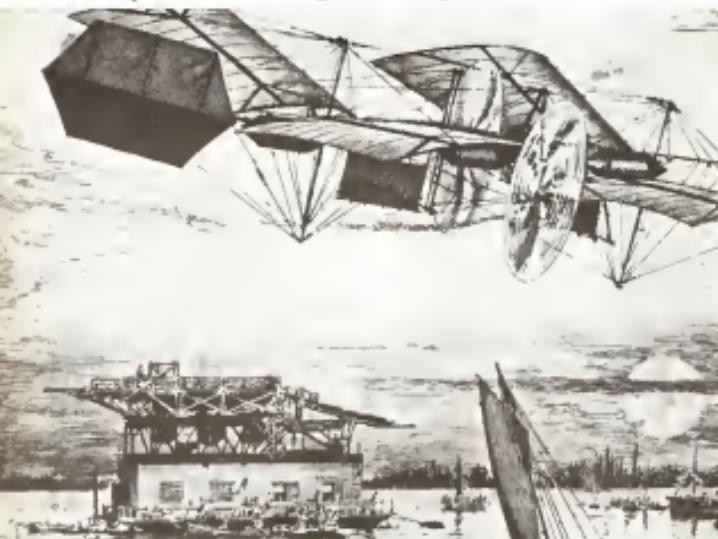
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The Achilles heel of all aviation equipment is reliability. At Western Gear, we have identified our product contributions with the slogan, "The Difference is Reliability." Western Gear produces test stands and components that are designed with capabilities to quickly and efficiently check out wide varieties of both airframe and ground equipment. The module illustrated is indicative of Western Gear design and productivity; it was specifically designed to completely, quickly and accurately check out the Van-Duct Drive used on the Convair F-106. In this instance, the drive is also our product. No matter what your test requirements may be, Western Gear can make an outstanding contribution to the effective solution of your problem. Write, wire or telephone now to



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Propulsion through the ages...



Photograph "B" (b) of Prof. Samuel P. Langley, 1903

An outstanding proposal - in 1903, down at the village, Professor Samuel P. Langley, then Secretary of the Smithsonian Institution, dreamt of this stupendous success, and with good reason. Models of his "aerodrome" had successfully flown over the Potomac. Langley was the first of the pioneers with lightweight power at his disposal - a 54-hp. engine turned two paper propellers. Two attempts were made to fly the full-scale machine from the wooden houseboat, at October 7 and again in December 8, 1903. Each time it plunged into the river. An official report cited the launching catapult as cause of the

failure. Nine days later the Wright brothers flew - today, near the banks of the Potomac, Rotol, the world's most experienced manufacturer of turbo-propellers, maintains an American subsidiary, Rotol Incorporated, for their sales service on turbo-prop in North and Central America and Caribbean service. Over 100 aero and marine operations throughout the world attest to the reliability of Rotol turbo-prop, standard equipment on the Vulcan Yacht, Frischield F-21, Grumman Gullwing, and Fairey Sealab.

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- Available now up to 22" in diameter, lengths to 25 feet (soon to 50').
- Flexions prove failure-proof—right up to burst pressures of hose!
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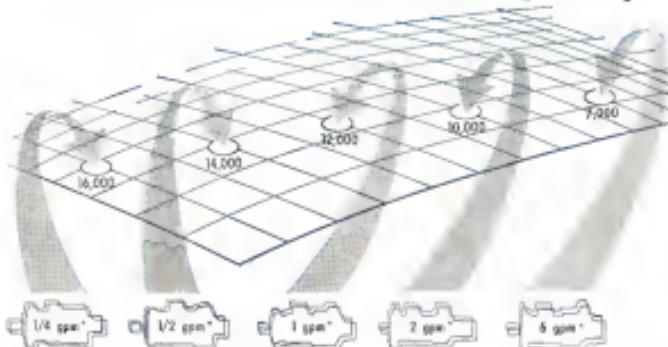
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But even "regular" models fit our scripted speed standards

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With STRATOPOWER "high speed" denotes not a specific group of models but a characteristic. No departure from basic design has been made to achieve high speed capability—STRATOPOWER engineers have simply "fit out" the speed favoring factors inherent in a thoroughly tried and proved design. The experience gained with "high speed" pumps has readily been fed back into "regular" models.

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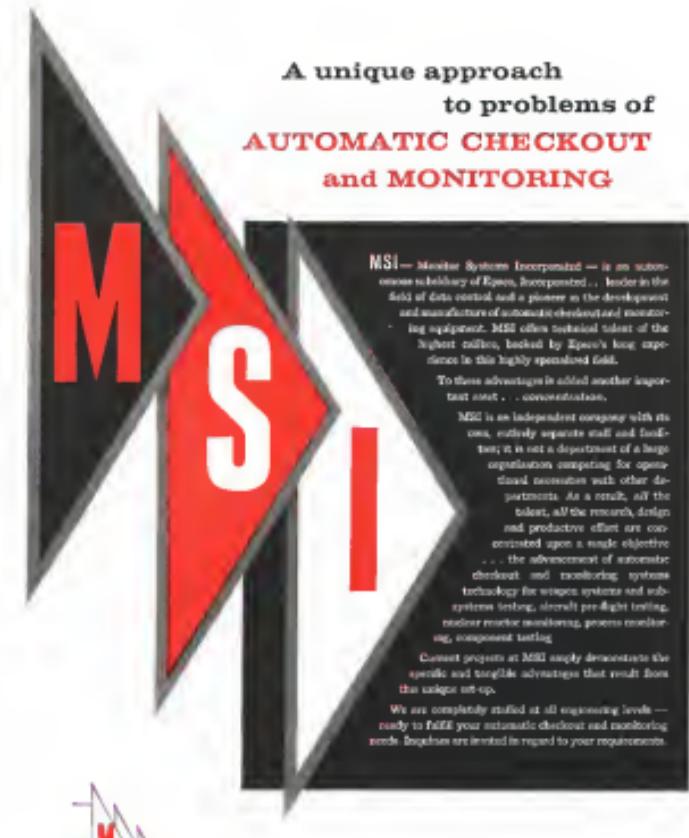
Before discussing any hydraulic application possibility on the basis of excessive speed requirement, check with your STRATOPOWER representative. He will be happy to discuss models and speeds in combinations you never before considered. It is possible that, in your specific application, even the speed shown above can be exceeded considerably.

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This FAA data processing contract is but one of a number of current airborne and ground-based programs reflecting SPI's capabilities as systems manager. Supporting these programs is a "systems" oriented technical organization, a "customer" oriented management, and a complete capability from research, engineering, and manufacturing on through to customer service.

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EDITORIAL

A Dangerous Decision

The decision to cut the B-70 Mach 3 bomber development program to a bare skeleton (see p. 28) is one of the most dangerous decisions made in this country during the past decade. It is incompatible in character and magnitude of error to the historic post-war British decision to abandon the pursuit of supersonic flight with manned research vehicles—a blow from which British aviation has not yet recovered.

The B-70 development program represents considerably more than any possible economic effect on North American Aviation, Inc., the prime contractor, or the array of subsystem developers and subcontractors scattered throughout the country.

In its essence, the B-70 program is the spearhead of the research effort whose goal is the development of the next significant generation of aircraft—both military and civil—which happens to be in the Mach 3 area. It also represents the effort to preserve a basic vital element in any future aerial war, whether fought with missiles, manned vehicles or both.

This is the ability to penetrate any enemy's territory and return safely. Without this ability even the strongest missile capability is subjected to severe limitations in its potential effectiveness. The ability to penetrate successfully and safely is necessary even for the effective use of ICBMs because they are blindfold without accurate pre-launch reconnaissance information to precisely locate fixed enemy targets, to provide the latest data on possible enemy targets and to provide post-attack information on damage results and to avoid attacking targets. It is also necessary because there will always be significant military targets that are either too mobile for an ICBM assault or too well concealed. For these targets, an aerial vehicle will always be necessary to locate, attack and destroy.

Skepticism Justified

It is true that the B-70 decision, which was bitterly opposed by the Air Force and imposed to fit it as a greatest White House-Budget Bureau object, does leave the shell of a Mach 3 aircraft research program remaining. However, in view of the preliminary whittling down that year on what was once a major program, certain skepticism appears justified in assuming that the whittling will not stop with the Fiscal 1961 budget decision and that over the remaining program will have difficulty in surviving another round of "economy" budgets. Next year it will be even easier to justify the final slash because of what little remains after the current chopping and its shift from a weapons system to a research program.

The basic effect of the B-70 budget slash decision is to artificially create a tremendous technical gap in our strategic deterrent force by destroying Strategic Air Command's ability to rely primarily on its subsonic Boeing B-52 and B-52 bomber fleet and a significant Minuteman and Polaris missile force as a replacement force for seven years hence. And even then it will have that missile force without sufficient reconnaissance or follow up strike

capability to be truly effective as a strategic deterrent.

It may be difficult for military men trained by an organization that is still using the Browning automatic rifle designed in 1910 and a standard service pistol used against the Moors by the then Capt. John Pennington before the dawn of the 20th century, to fully comprehend the speed, scope and significance of the impact of random technology on military weapon development. With this type of background it is not surprising that they are disturbed by the viewing technical gap they are creating and still caution against a "speculative" hysterical urge about the benefits of getting something new."

Financial Wringer

Some people have suggested that this gap will be adequately filled by the Mach 2 Convair B-58 bomber. The B-58 is a fast weapon and a significant step forward in improving the military capability of Strategic Air Command. Until recently it has been graded to the limit of its manufacturer's technical ability. It is still the only such aircraft existing in the world today. But the B-58 has been put through much the same financial wringer that is now squeezing the viability from the B-70 program. Consequently, unless the course of these Jacksons is also reversed, the B-58 will enter the SAC inventory in too small quantities, too late to ever realize its genuine military potential.

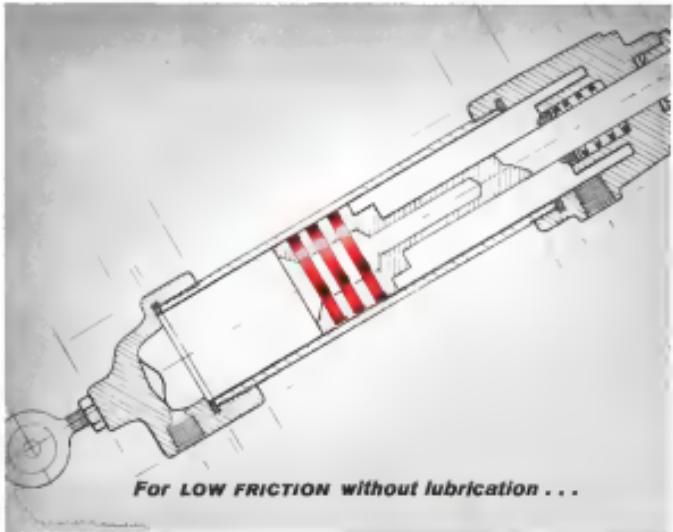
On the civil side, the curtailment of Mach 3 aircraft development will bind to the Soviet Union another opportunity to strike a tremendous blow at this country's technical prestige and our air commerce, which today is unquestionably the finest in the world. The development of a supersonic transport will be the key to the next generation of international air transport. All concern evidently points to the Mach 3 range as the most promising for this effort.

As anybody in the aviation business knows, the development of an aerodynamic research vehicle to fit at Mach 3 and the continuation of development on all of the vital subsystems required to make it function as a useful civil or military vehicle will take little genuine progress toward any significant goal. In fact, when the B-70 prototype flew in 1962 without these vital sub systems its achievement will be as hollow as its empty airframe. This will, of course, give its critics even more grounds to slash the program because it obviously has not produced a truly useful vehicle.

This is the process of stretchout and technical cancellation by which we are letting the blood of our strategic shabby spill out into the barren ground of false economy. This is how we are blushing the dynamics of our technical pace.

The B-70 stretchout decision is supposed to save \$85 million in Fiscal 1961. This may be true but the ultimate price of this economy may be our existence as a free and independent nation.

—Robert Holt



Look for piston rings made with TFE resins

To overcome the problem of friction in the hot afterburner nozzle control of a turbojet engine (shown above), piston rings made of a filled Teflon TFE resin were used. The non-lubricated rings have performed smoothly for over 200 engine hours without a sign of failure, despite high operating temperatures and the presence of corrosive hydraulic fluids.

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WHO'S WHERE

In the Front Office

Carlo L. Rogers, a director of American Airlines Inc., Mr. Rogers has joined the American, Mackay and Franks Co. American also elected **Douglas D. Taylor** a vice president; he will continue in charge of the company's Washington office.

C. R. Able, vice president-director of grants, Douglas Aircraft Co., Inc., Santa Monica, Calif.

Dr. George J. Donohue, president and a director, Aeromatic Research Associates of Princeton, Inc., Princeton, N.J. Also: **Roger D. Sullivan**, associate consultant and a vice president and a director, Edward Seckel, a director. Mr. Seckel is associate director in the Department of Aeromatic Engineering at Princeton University.

James O. Keet, vice president for flight Air Lines in North America, succeeded **Michael J. Dugan** who is returning to Dublin to resume the position of assistant general manager.

H. H. Gray, a director was promoted and appointed director of manager, **Richard J. Sander**, a director of Northwest Corp.

Walter J. Knott, executive vice president, **Hoffmann Electronics Division** of The Singer Corp., Andover, Calif.

Richard A. Campbell, vice president operations, **Pacific Semiconductor, Inc.**, Cambridge, Calif., a subsidiary of **Thomson Ramo Wooldridge, Inc.**

Stanley L. Schatz, assistant director, Air Navigation Traffic Control, **Air Transport Asia**, Washington, D.C.

Gen. Adm. Leonidas D. Costin, Jr., presently Deputy and Assistant Chief, Bureau of Aeronautics, assigned to the Office of the Chief of Naval Operations.

Howard P. Remond, Chief of the Analysis Division, Office of Plans and Requirements, Federal Aviation Agency, Washington.

Honors and Elections

Dr. Howard S. Seltzer, general contract for performance development at Space Technology Laboratories, has been elected president of the American Rocket Society. **Donald W. Ritter**, vice president and technical director of the Rocket Division of Thiokol Chemical Corp., has been elected Dr. Seltzer's vice president of the society.

James S. McDonald, Jr., president of McDonnell Aircraft Corp., has been elected chairman of the board of governors of the Aerospace Industries Ass., succeeding **C. E. McCorff**, chairman of **Cessna Vehicle Industries**, Kansas City, Mo., president of the **Division of General Dynamics Corp.**, was elected vice chairman.

Frederick C. Cordon has been elected president of the National Aerospace Ass., succeeded **Thomas G. Lamphier**, Jr., a vice president of Convair, who was elected chairman. **Marie D. Daniels**, president of **Convair Corp.**, was elected first vice president.

Robert E. Whetstone, vice president engineering, manager and vice president for **Douglas Aircraft Co.**, Inc. has been elected chairman of the newly organized **Global Missile Council**, Aerospace Industries Ass. (Continued on page 172)

INDUSTRY OBSERVER

► Projections for test stands to accommodate 24 million-lb-thrust powerplants are being analyzed for location at Edwards AFB, Calif. Big problem would be ability to control acoustic plumeaus. Embedding a new design concept, test stands would serve Air Research and Development Command and National Aeronautics and Space Administration projects.

► **Bendix Corp.** is performing a study for Air Force Ballistic Missile Division under the Minuteman orbital-propellant ballistic missile program to determine hard-base auxiliary power requirements to ensure missile operational capability if all other power sources to a base should fail.

► Third **Ballistic Missile Early Warning System (BMEWS)** installation will be made at Fylingdales Moor in East Yorkshire, England, instead of in Scotland as earlier planned. New BMEWS installation is expected to have four large surveillance radar antennas, similar to system installed near Thule, Greenland, aimed so as to detect missiles launched from southern portions of Soviet Union or its satellites as well as missiles fired over polar regions from northern sites.

► Planning is under way to establish a specific timetable for transfer of responsibility for executive management of the Asia ICBM from the Ballistic Missile Division to the Strategic Air Command for operational status and the Ballistic Missile Center for logistic support. Specific programs for transfer of Titan are scheduled to follow within the next fifteen. These will be followed shortly by a timetable to switch the management responsibility for Minuteman, still in its early research and development stage.

► Japan may order a total of 20-30 F-104Ds from Lockheed Aerospace Corp. if the Lockheed fighter is officially chosen for the Japan Air Self Defense Force. Aircraft would be used for training before the F-104J begins costing of the production lines in Japan. Japanese purchase would probably about 700 of the Lockheed fighter under license, and approximately 180 would be the two-seat F-104C-1 version. F-104C-1 has the same general weight, dimensions and performance as the basic F-104, although some different avionics equipment will be used.

► **Siemens**, advanced television reconnaissance satellite of the WS-117L program, is being analyzed for logistics and support literature requirements relating to the size the system is expected to be phased into operational status with the Strategic Air Command.

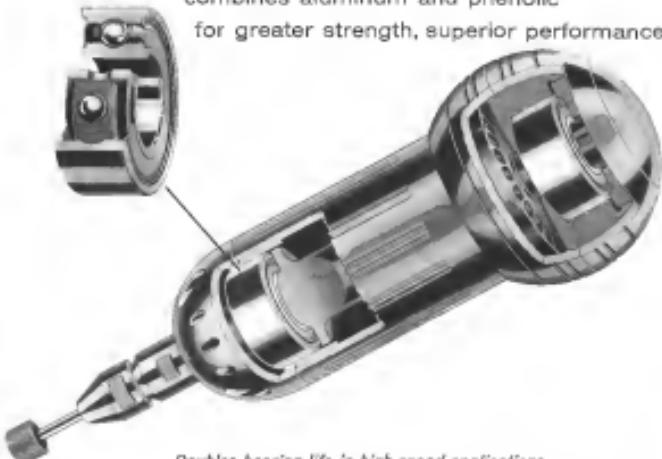
► In **Safe** break development program related to the Asia, Titan, Thor and Minuteman nose cone reentry techniques, **Brennan Pioneer Co.**'s Defense Research & Development Co. division is working on cutting down bomb weight by reduction of fair weight and the substitution of aluminum for steel parts. Another refinement is an absorption of a time fuse as is in the tail fins for the Minuteman type. Company also is working on stage separation devices for Minuteman and Mercury projects and distinct sections for Minuteman.

► **Martin** is producing research and development ground equipment costing about \$150 million for use in connection with captive test and launching of the Titan ICBM.

► Automated repair parts provisioning unit which could be applied to aerospace items such as the Polaris fleet ballistic missile and the upcoming generation Polaris ballistic missiles has been developed by **Planning Research Corp.** for the **National Defense Supply Office**.

► **Lockheed Aircraft Corp.**, Burbank, is analyzing future ballistic missile mobility possibilities encompassing transportation by rail, truck and water. latter study includes large LST-type barges with provisions to be sunk and enclosed in shallow-water bottom for the section of the missile to vertical, then refloat barge after firing. Studies are company-funded.

BARDEN "T" retainer
combines aluminum and phenolic
for greater strength, superior performance



Doubles bearing life in high speed applications

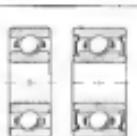
Power tools, gyro rotors, aircraft and missile accessories and other high speed applications require bearings that combine high load capacity and endurance at speed. To meet these exacting demands, Barden developed the "T" hub retainer which combines the advantages of phenolic with the strength of aluminum.

The two-piece "T" retainer has laminated phenolic center sections bonded to high-strength aluminum alloy side plates. It is a securely joined by body-housed rivets tightly bonded against metal at both ends. The retainer's thin cross section permits minimum expense of hub and increases its life expectancy. Outer ring piloting provides optimum lubricant circulation. These features, together with high load capacity, result in longer, trouble-free bearing life. For example, double shielded, grease lubricated "T" retainer bearings have operated continuously in textile spindles for more than 18,000 hours at 30,000 RPM.

Like other Barden advances in engineering and manufacturing, "T" retainer bearings solve a specific performance problem. Other Barden precision ball bearings, usually with extreme demands as:

- High temperatures (up to above 400°F)
- Low torque (up to dynes-cm) for 2.5 lb. load
- High speeds (up to over 300,000 RPM)
- Constant rotation (up to 0.0005" max. TIR)

The complete Barden line includes sizes from 0.007" bore to over 3" O.D., all manufactured to Barden Precision standards of dimensional accuracy, uniformity and reliability. Refer to Sweet's Product Design File (Myl/Bu) for Barden catalog and bearing selection guide.



"T" retainer bearings are available in choices of standard steel types or shielded from .009" O.D. to 3.340" O.D. in standard widths. Also available are special designs with increased lubricant space for still longer life. For complete technical information, write for Engineering Data Sheet T-1.

for reliability—reality

BARDEN **PRECISION BALL BEARINGS**

THE BARDEN CORPORATION, 3022 Park Avenue, Boston, Massachusetts
Western office: 5200 Wilshire Boulevard, Los Angeles 45, California.

Washington Roundup

New ASW Command

Watch for a Navy announcement within the next few days to establish an integrated anti-submarine warfare force in the Pacific along the lines of the Atlantic Fleet's Anti-Submarine Defense Force which has long been in existence for the past few years. Commanders of the new Pacific force being organized in an effort to tighten defenses against Soviet missile submarine will be Rear Adm. John S. Thach, who has commanded Task Force ALFA since it was organized only last year to carry out extensive exercises to help determine Navy's equipment needs in that field and to improve ASW operational techniques. Thach, who will gain the rank of vice admiral with the transfer, is expected to move into his new post early next year.

In a related move, the Navy announced last week that Rear Adm. Edmund B. Taylor, now commander of the Atlantic Fleet's submarine force, will succeed Vice Adm. William R. Cooper as commander of the Atlantic Fleet's Anti-Submarine Defense Force. Taylor also will be promoted to the rank of vice admiral.

Navy also named Vice Adm. William R. Smithing III to the post of deputy chief of naval operations for personnel, replacing Vice Adm. Harold P. Smith. No new assignments were mentioned for either Cooper or Smith, but Smith has been mentioned previously as the man as a possible successor to Adm. Joseph Wright as commander of the Atlantic Fleet and NATO sea forces upon the latter's retirement next year.

Patent Policy Review

Controversial National Aeronautics and Space Administration patent policy was eventually upheld in a complete overhaul of national patent policy. Unlike other federal agencies, NASA is legally required to take title to all inventions made under its contracts and its situation has presented the National Council of Patent Law Attorneys with the thorniest issue of all existing and proposed U.S. patent legislation. Review will be made to help Congress frame legislation to establish a uniform national patent policy for all federal agencies.

Apples and Oranges

Richard E. Horner, automatic administrator of the National Aeronautics and Space Administration, was asked on a television news program last week why the U.S. did not follow the Russian plan of using "redets in depth" and more than one of the same type of vehicle to back up specific space efforts. Horner replied:

"I think we have greatly limited our program around a concept of a broader scope of different kinds of vehicles than the Russians have and relied on a backlog in the sense of a flexibility in switching from one endeavor to another, rather than to use our resources all in one specific endeavor."

Aided a moment later, "What are some of the different areas where we are preparing projects in which the U.S. is involved?"

"I find it a little difficult to answer that question in the context of what we are doing, that the Russians are not doing because we have very little information on what the Russians are doing and after they have done it. And of course we are talking now mostly about things that we are proposing to do . . ."

Accident Data Release

Previews by the Civil Aeronautics Board against the Federal Aviation Agency practice of releasing recordings of tower-pilot conversations immediately after an accident are not likely to bring about any changes in the policy. FAA officials point out that any broadcasted information automatically becomes public information once it is on the air, it is available to any listener. For this reason, FAA says the information cannot be immediately withheld, and, therefore, will be released—a practice that is never applied to other data concerning an aircraft accident. According to FAA, the CAB has been the sole objector to the policy, and no similar complaints have been received from air carriers.

Bahamas Guest List

Controversy over releasing names of officials entertained by the Martin family at the Bahamas Elephants Club on the Bahama Islands (AW Sept. 23, p. 25) came to a close last week when the House Armed Services Committee, Subcommittee A released a guest list of over 25 high-ranking officials, Defense Department officials and industry representatives.

George M. Shultz, Martin board chairman, presented a list drawn from his collections to the subcommittee in executive session in September. Shultz called on the subcommittee, headed by Rep. Edward Robert (D-4a), to make the list public. Robert replied that the list was Shultz's and it was up to him to make it public.

Subcommittee released the list last week after an individual check on each of the names supplied by Shultz. The guests included Air Force Secretary James H. Doolittle and Gen. Nathan F. Twining, chairman of the Joint Chiefs of Staff. It was reported that Douglas paid his own expenses. Twining was a Martin guest in the Bahamas on three occasions Mar. 7-18, 1957, Feb. 14-16, 1958, Feb. 20-Mar. 1, 1959.

Chavez Budget Views

Sen. Dennis Chavez (D-N.M.), chairman of the Senate Appropriations Subcommittee for the Armed Services, is satisfied with an overall figure of \$61 billion for the fiscal 1964 defense budget. The aim is which to raise savings. Chavez suggests, is in tightening up on contracts. "We are getting paid more than we are worth," he commented last week. The greatest need for improvement in the military establishment, he added, is in housing and hospital facilities.

Christmas Mail Boost

Christmas mail deliveries will be expedited this year as a result of an agreement between the Post Office Department and the Defense Department. Pending a Civil Aeronautics Board decision on the use of transport of non-priority mail (AW Nov. 23, p. 46), the carriers have agreed to transport first-class and commercial air-mail letters this month at rates of approximately 30% of those currently paid by the Post Office for the carriage of airmail mail. The one-month trial, however, is increased only to aid annual delivery during the holiday season and has no bearing on the final outcome of the airmail-privity mail case.

—Washington staff



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MICHAEL P. KIRKLAND CO.

AVIATION WEEK's conception of B-70 carrying a Dynaflite type vehicle is one of several variations proposed for the aircraft.

Budget Cuts Force Stretchout of B-70

Major subsystems eliminated, flight date delayed; North American will recall airframe subcontracts.

By J. S. Blair, Jr.

Washington—Stretchout of the North American B-70 Mach 3 bomber program, including the elimination of major subcontracts, was announced by the Air Force last week after its appropriations request for the project was reduced by the Administration from \$769 million to \$75 million for Fiscal 1963.

The reduction in funds will cause the loss of approximately 2,000 North American employees in Los Angeles Division and has forced the cancellation of contracts for three major B-70 subcontracts under development. These are

contractor and approach:

• Initial type homing navigation system being built by the Technical Systems Division of International Business Machines Corp. The stable platform, which is the heart of the system, was subcontracted to the Aerospace 1960 unit of North American. Approach and 550 systems had been spent on this program to date.

• Electronic countermeasures system for passive defense of the aircraft against guided missiles which was under design by the Air Arm Division of Western Electric Corp. Investment in this system amounts to about \$2.5 million to date.

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• Missiles and traffic control equipment consisting of communications, navigation and avionics identification equipment. Western Electric Electronics Center at Motorola, Inc., was the sub-

contractor and approached \$100,000 had been spent on the system.

A total of approximately \$130 million has been appropriated for the B-70 program through Fiscal 1962 and all but \$75 million of this has been released by the Department of Defense. Estimated commitment of funds to date has been estimated at between \$140 million and \$160 million, left the Air Force with only \$10 of the \$75 million that has been approved and released to date. The \$70 million available for the B-70 for Fiscal 1963 is approximately \$13 million.

The most recent count, however, will make it possible to build only one aircraft, which would be designated the XB-70. Purchasing funds at present are expected to begin with the first production aircraft. In a memorandum, the Air Force has informed the B-70 and B-72 test teams that the aircraft will be completed before the end of the year. The aircraft will be delivered to the B-70 test team in time for the first flight of the production type B-70 to be made

planned for 1962 but, under the new plan, the single test aircraft will not fly until 1963.

If a significant number of completely equipped B-70s is to be in operation by 1970, a decision will have to be made next year by the Administration to terminate the bombing-navigation, electronic countermeasures and missile control system program. A number of industry and Air Force officials believe that the Administration's hold-the-line defense spending policy will not be changed for Fiscal 1963 and that there is a strong chance that any additional defense budgetary increases will be concentrated on weapons which are proven to be effective in the present budgetary period.

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For a manned fighter-bomber capable of operating from land and sea bases up to Mach 2 it was pointed out by Dr. Edward A. Wilson, deputy director, research and engineering, Department of Defense, in a speech to the American Defense Arms in New York last week.

USAF Resists

Top-level Air Force officials, however, are believed to favor an all-out appeal to Congress and another bid to the Administration for maintenance of the original B-70 program. The Air Force and its advisors such as Theodore Von Karman (AW Sept. 23, p. 20) are reluctant to abandon the concept that a mixed force of missiles and manned aircraft is necessary in any future conflict. One part of the effort to make the B-70 more competitive is to have it be able to carry electronic countermeasures of the air traffic control mission capability.

Under these studies, it has been established that the aircraft could serve as a recoverable first stage booster for satellites and Dyna-Soar-type boost glider vehicles. The B-70 could drop a 10,000 lb. glider with about 40,000 lb. of upper-stage boosters at 70,000 ft. and at Mach 3 speed. This rocket could reach a 100-mi-high angular orbit. Maximum payload of the B-70 for short range should approach 100,000 lb.

Transport with about 30-passenger capacity. If the fuselage were widened and lengthened somewhat, the passenger load could be doubled. Such an aircraft probably would be out of the financial reach of U.S. defense if it did not come as a bonus from the B-70 program. Senior officials have stated

V-STOL Fighter

Air Force will buy a new jet fighter-gnatily a V-STOL-type which contractors will be asked to submit designs early next year. In 1962, contractors will be with current discussions between Tactical Air Command and USAF Air Staff concerning configuration of fighter needed. Funding already has been set aside for Fiscal Years 1968 and 1961 programs, and will be made available when the competition is completed. USAF anticipates it will spend the closely approved money as 1960. Design studies are expected to start in November, Contract Bell, McDonnell and Republic.

Need for a manned fighter-bomber capable of operating from land and sea bases up to Mach 2 was pointed out by Dr. Edward A. Wilson, deputy director, research and engineering, Department of Defense, in a speech to the American Defense Arms in New York last week.

probably that they have a superior program under development.

• **Another interceptor** for the Air Defense Command. This proposal has raised many doubts as to the economics of operating a \$100,000 to \$60,000 lb. aircraft for air defense and it is not easily discarded. It should be shown, if it is chosen, to be a smaller fighter than the B-70. However, if the B-70 should be the sole Mach 3 aircraft built in the U.S., it will prove advantageous to incorporate some of these ideas in the fighter. They could carry a large number of air-to-air missiles, very long range search and fire control radars and, once they were in the air, do the work of at least three Mach 2 fighters. The B-70 in its SAC configuration is designed to be off the ground in less than five minutes after receiving a warning, including simultaneous starting of its engines plus a very rapid automatic checkout of its avionics systems. This would add to its combat value to a fighter with fuel injection and variable potential.

• **Announced** of the B-70 could carry bombs, air-launched ballistic missiles and air-to-ground cruise missiles. To make the B-70 a true strategic aircraft, which could intercept in the B-70 or directly to a SAC airfield. Operation of this wide variety of weapons either has been announced or is in the part for other aircraft or was planned before the B-70 was originally scheduled for first squadron service in 1964 or 1965.

• **Cost** of the B-70 would allow it to be converted to nuclear power once the U.S. develops this type of aircraft propulsive. The cross requirement is about 75 ft. ahead of the combat air side for its engines which would cause the personnel shielding problem. The

jet engines are located next to each other so that they all could be applied with heat from one central reactor which probably would be located off of the duct inlet near the center of the wing.

Most of the B-70's multi-function structure stems from the fact that its thrust-to-weight ratio is very high for a large aircraft. It will weigh something less than 600,000 lb. and have a total of at least 180,000 lb. of thrust in its General Electric 193 engines. The B-70, B-52, for comparison, weighs around 400,000 lb. with 180,000 lb. of available thrust. The power advantage should enable the B-70 to operate B-52 aircraft with room to spare and contribute to good performance in all types of flight.

York's View

A statement last August by Dr. Herbert F. York, Defense Department director of research and engineering, appears to reflect generally the attitude of officials having analysis heavily. After stating that "we simply are not prepared to answer" whether the air-launched F-105 or the B-70 programs would reach the hardware stage, Dr. York added that "some people have lingering doubts" about the reliability and economy of missiles, but "I don't have any doubts myself."

Major Gen. John B. Medina, retiring commander of the Army Ordnance Materiel Command, recently said he felt "the manned bomber is necessary on the decline because of the growing

Life on Venus?

Washington—Possibility that life may exist on Venus was raised last week when a team of four high-fidelity biological flight models created the pressure of water vapor in clouds surrounding the planet.

Costs: Michael Rau and astrobiologist Charles S. Moore of Arthur D. Little, Inc., went to \$40,000 for a Navy Inform equipped with a telescope and a telescope designed by Dr. John Strong of John Hopkins University.

Preliminary inspection of the data recorded indicates that water vapor did exist on Venus, but more detailed information will be needed about surface temperatures before definite conclusions can be drawn as to the existence of even the most elementary forms of life on the planet.

Scientific opinion is widely divided at present over the range of temperatures in the surface of the planet, made by the temperature ranging above 800°C. Other observations have indicated temperatures similar to those on earth.



Lockheed YP3V-1 ASW Electra Version Makes First Flight

Operational prototype of U. S. Navy's Lockheed YP3V-1 anti-submarine patrol plane (AVW Feb 23, p. 36) has made its first flight at Burbank, Calif. Tail boom on Electra version houses electronic detection gear and new nose section carries radio equipment. Propellers are Allison T56-18-W turboprops developing a total of 18,800 shp at takeoff. Plane can be fitted to carry external rockets. Company says the YP3V-1 can reach 280,000 sq. ft. in a single flight at a cost of about one cent per square foot. Cruise speed is about 480 mph. All-new type windows have been replaced with large observer stations.

strength of the air defense in terms of guided missiles, both our own and our opponents'. What the time period will be I don't know, but certainly it is definitely declining, and I should think that four or five years would be it is a reasonable time.

French Air Force doctrine at this stage depends heavily upon the B-57 and if the aircraft fails to reach operational service, this doctrine probably will require a later overhaul. Air Force leaders believe that air superiority by manned aircraft is still required and that it will continue to be required for the next 10 years at least—the minimum period for which first operational equipment needs generally are projected.

At any rate, USAF believes, depends upon ability to penetrate all targets, no matter how well they are defended. The French believe that the B-57 will not be available in the early 1970s. The Air Force feels it can receive adequate information on damage the targets has received and on his actions during the second phase of any silicon nuclear war. Manned aircraft also are considered by USAF to be the only weapons that can ensure the success of attacks against relatively small targets such as missiles.

Air Force estimates of missile capabilities are that no long range missiles will have the accuracy or yield of weapons dropped from bombers before 1970. Absolute destruction of targets smaller than large cities will require large numbers of missiles before that period, although the ultimate accuracy of ICBMs is predicted to be good

enough to disrupt missiles in hardened sites on a one-for-one basis at 5,000-mi. range. Reconnaissance satellites and missiles with anti-satellite equipment will not be accurate or reliable enough to be considered for this vital mission before 1970, according to some Air Force officials.

Soviet Defense

The doctrine of manned penetration is now being implemented by a short-range bomber fleet. However, the Russian air defense against this force will be much weaker, according to intelligence estimates. Air Force planners believe that this defense already is strong enough to lower the penetrator rate of strategic bombers with current equipment to an unacceptable figure. Steps have been taken to increase the effectiveness of the development of long-range, ground-based defense systems, nuclear missiles and anti-surface missiles.

U. S. plans apparently are to attack in such penetrations screened by ECM and decoy missiles, while firing long numbers of Honest Dogs at the ground-based defense systems, nuclear missiles and anti-surface missiles.

If Soviet air defense continues to be improved in the present year, Air Force intelligence sources estimate that the development of long-range, ground-based defense systems, nuclear missiles and anti-surface missiles, the French Quail decoy missile and more sophisticated electronic countermeasures equipment. An extensive replacement of ECM with these items is scheduled to begin this year. The maximum production of the Honest Dog is scheduled for 1969.

Concern to some regards, the primary purpose of the Honest Dog is not to enable a B-57 to attack a target from distances beyond range of defense. The normal mission is for each B-52 to attack its prime objective after re-leaving its four Honest Dogs at other targets on the way. Another air objective for Honest Dogs as the last three refueling stops should be counted upon to aid the U. S. defense posture before 1970.

enemy air defense systems. It is expected that the bomber forces will attack in numbers and fight their way to the main objectives. According to Gen. Edward Parpart, retired commander of the North American Air Defense Command, the easiest air defense situation is an attack by single aircraft or small groups, with maximum penetration being attained by attacking with close spaced waves of large groups of aircraft in use air defense sector.

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French Delay Mirage Bomber Decision

Paris-French military budget for 1960 contains authorization for the eventual ordering of 30 Dassault Mirage 5A strategic bombers although final decisions on purchase of the transonic bomber is being held up.

Paris, Gaullist, French armed forces minister, revealed this at the end of the National Assembly debate on the 1960 military budget. Mirage 5A is to be a single prototype flying as a powered by two SNECMA Atar 9C engines. It is capable, Gaullist said, of carrying 10,000 lb. of bombs which "we hope to manufacture."

Production of that first French strategic bomber, however, will remain under a cloud. Gaullist said: "The decision to build the production version depends on a new decision of the prime minister and probably of the entire national defense committee."

Earlier in the Mirage 5A debate, Gaullist defended his department's decision, made several months ago, to stay with the Atar-powered, Mirage 5 instead of using Pratt & Whitney J75 turbines (AVW No. 16, p. 99). Range of action of the Atar version, he said, permits it—with or without midflight refueling—to fulfill its mission as defined by French officials.

Although Gaullist didn't elaborate on this point, it is generally understood that Air Force leaders of the Mirage 5A force feel the one strategic mission, landing perhaps in the Near East after overflying Russia, targets. Many French military leaders expect that in an atomic war, it will be most worrisome about returning planes to takeoff point.

In addition to the 30 Mirage 5A bombers, the 1963 budget includes 100 missiles for 100 additional Mirage 5A interceptors. This brings to 200 the total number of Mirage 5 is authorized by the French Defense Ministry. Other interceptors in the force budget include 100 Mystere 4s and some 513 fighter missiles such as the anti-aircraft, ballistic missile or cruise type missiles not considered to be any more durable than missiles launched from land or sea if they are not used to mount an aircraft in penetrating over a target. Mirrored aircraft, USAF planners say, cannot be justified simply as long-range missile interceptors.

France-Soviet weapons systems with extremely high speeds are considered by the Air Force to be at least 10 years from operational status and that only weapons that have been under serious development during the last three refueling stops should be counted upon to aid the U. S. defense posture before 1970.

Within the overall military budget there is an item for \$84 million which represents new authorization for nuclear

weapons development. Another item amounts some \$10 million of reformation funds for development work on an intermediate range ballistic missile project, "either French or Alred."

Use of American surplus fighter aircraft as ground support fighters in Algeria came in for heavy criticism during the budget debate.

Since 1956, the French air force has used American fighters in North Africa. It is with regard to this that the French are most critical. It is impossible, Gaullist said, to estimate final American deployment of the French atomic bombs which "we hope to manufacture."

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It was understood that the U. S. decision was privately agreed to by both Pentagons and State Department officials.

At the time the U. S. reached its decision, several U. S. aircraft companies in Europe already were deeply involved in talks with the French missile subcommittee.

The company involved, SNECMA, Safran, Dassault and Dornier, was the largest.

(AVW No. 16, p. 99) was set up earlier this year.

It is composed of most

French aircraft companies plus several government agencies. SNECMA's mission is to coordinate efforts of French companies in building of an IRBM as well as to deal with American companies which were slated to take part.

It was that the French IRBM missile, probably in the 3,000-3,500 mi range and based on solid propellants, would be both early American technology old and be aimed with French nuclear warhead. It was to be ready by 1965.

U. S. aircraft companies, anxious to participate in French IRBM program, by the end of last August already were working out initial projects with the French when, as one source in Paris put it, "all hell broke loose." Since then, no further talks or negotiations have been exchanged between the American companies or government officials and the French. At first, an official misgiving—either from French or U. S. sources—had been work of the new situation. Apparently French Ambassador's visit with Gen. Charles de Gaulle in Paris last September did not alter the U. S. decision.

It was impossible to learn whether the U. S. ever really intended to cooperate with France on a bilateral basis on the IRBM project. One specific idea had it that the U. S., under a resolution passed at the NATO summit meeting in December, 1957, was willing to help the NATO group develop an intermediate type weapon such as an IRBM, but was ready to work out the bilateral deal.

U. S. companies, however, fearing France was interested in developing its own IRBM, began talking with the French. It was at this point, speculation goes, that Washington stepped in and stopped down the U. S. companies

in being 25 killed and 11 injured. In answer, Gaullist explained that 50% of such losses were due to inferior French anti-aircraft fire, and not to the qualities of the IRBM.

Suspicious over use of American surplus aircraft in Algeria spotlighted that aspect of the French aircraft industry over the past five years that has declined and developed generations of its best fighter aircraft specifically designed for the type of warfare the French have been fighting in Indochina and in Algeria.

These aircraft began with the Potez 75 and include such prototypes as the Morane-Saulnier Espanier, the SIPA 1100, Sud Aviation's Vigilant and Dassault's Ouragane. Each of these aircraft was designed at the request of French Defense Ministry. But the Ministry has continually abandoned these French projects to favor American surplus aircraft at cheaper cost.

U. S. Refuses French IRBM Aid

French-French development of an intermediate range ballistic missile is being held up by the refusal of the United States to work with France on a bilateral basis (AVW Nov. 2, p. 37).

Uninformed sources held Aviation Week that American aircraft companies had been ordered by the U. S. government to cease all cooperation with the French on IRBM studies. The only, these sources claim, has just about brought to a halt any French IRBM activity. French officials have admitted it would be impossible for France to develop the IRBM and that U. S. help would be necessary.

Reasons for U. S. unwillingness to cooperate bilaterally with France on an IRBM project is not completely clear. It's likely the U. S. prefers to work out an arrangement under which U. S. technology would be given to a group of NATO nations for development of a NATO-controlled IRBM, rather than help France develop an independent weapon which would be controlled only by France.

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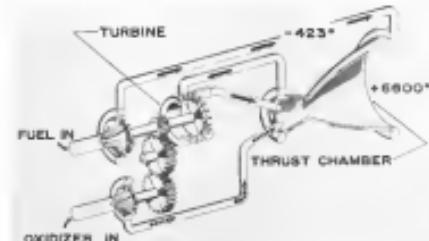
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Centaur Tests New Hydrogen Pump Cycle



FIRST PHOTO of complete Pratt & Whitney XLR-115 liquid hydrogen rocket engine being developed for Centaur Centaur upper stage for space vehicles shows propellant pumps and valves, which eliminates separate gas generators used in most liquid engines. Thrust below shows flow cycle of liquid hydrogen fuel and liquid oxygen oxidizer in XLR-115.



Washington—Pumping cycle that eliminates the need for a gas generator to be used as a rocket engine for the first time as engine of the hydrogen-fueled Pratt & Whitney XLR-115 P-1.

This XLR-115 thrust engine is being developed for the National Aeronautics and Space Administration. Two engines will power the Centaur Centaur upper stage for space vehicles. Specific impulse predicted are 10% higher than with liquid-fueled rockets.

Several XLR-115s have been fired for as long as several minutes in a number of tests at Pratt & Whitney's Florida Research and Development Center near West Palm Beach, Fla. (AW, July 27, p. 28). Hydrogen pumps of flight design have run them for more than two years.

The XLR-115 pumping cycle (see diagram) eliminates the gas generator used in most liquid rocket engines to provide turbine power for pumping propellants by expending on the great energy released in extremely cold liquid hydrogen as it expands into a gas.

Hydrogen is stored in the fuel tank at minus 473° and under slight pressure. First step in the cycle is to open a fuel line valve, allowing the hydrogen to pass through the pump. Combustion of the pressure and the much higher relative temperature of the engine parts cause rapid expansion of the hydrogen through a conventional nozzle, creating a high-velocity stream of hydrogen and combustion chamber. Even though the engine has not yet fired and the nozzle and chamber are at the relatively cold temperatures of space, they are several hundred degrees warmer than the initial temperature of the hydrogen.

The hydrogen, now in gaseous form, passes through the turbine. The turbine is geared to turn both the fuel and the liquid hydrogen pumps. From the turbine, the gaseous hydrogen flows into the combustion chamber. Because of the pressure required in the combustion chamber, the Centaur stage will have to jettison the cylin tank tank to thrust because it can't be jettisoned in less than a second.

Once combustion begins, temperature of the chamber will increase to approximately 5,600°F. The great expansion caused by the heat exchange as the hydrogen passes through the cooling jacket continues the operation of the pumping cycle.

The XLR-115 cycle also allows fuel tank pressure to be lower than in conventional systems, permitting the use of lighter tanks.

Charles T. Radke, general manager of the center, says this work has shown that there is no technical obstacle that

would limit the use of hydrogen engines of similar design.

At least three companies—Pratt & Whitney, Aerjet and Rocketdyne—have experimented with liquid hydrogen engines of thrusts above 100,000 lb., but no government agency has yet contracted for the development of the larger engines.

NASA reportedly has been limited by

a lack of funds from separating development of larger hydrogen rockets, although this may be done next year. An F-106 is understood to have withheld resources of larger engines, both because of lack of specific requirements and uncertainty as to whether such an engine belongs in the national booster program, which is under the supervision of NASA.

NASA Associate Administrator Richard E. Manner said last week that no landing vehicle could fit the lunar module, but he said "we have made study currently the possibility of changing our schedule to get the most out of the resources that we have available."

The No. 36 failure was tentatively blamed upon failure of the aerodynamic skirt around the payload. After was launched successfully, but 45 sec later the shroud apparently fell off, exposing the payload to severe guidance. Two-piece shroud was reported to have been separated by a gap of about 175 sec after launch, after the vehicle had reached some 15,500 lbs. velocity.

Parts of the payload found with the launching site indicated it may have been torn from the No. 36. After Able-1, but the possibility remained that the 25th flight's Aerobee and aluminum oxide engine in the payload may have exploded.

Telemetry Lost

Some telemetry was lost at 40 sec, about 70 sec, and at 104 sec after launch, all 100 miles as upper stages had been lost. Tracking information and first stage telemetry indicated that the last Able-10 engine cut off within one second of its 385 sec scheduled burning time. There were also indications that the American AJD-10A-powered second stage had failed with no indication of whether it separated from the Atlas. But as all of the first and second stages fell into the Atlantic Ocean off the Africa Coast, third stage, powered by the Argent Bantam X-248 solid propellant engine, may have been off or exploded shortly after launching.

Payload contained 121.2 lb. of scientific instruments, transmitting equipment and power supply aimed at measuring meteoritic impact, band radiation, total radiation flux, low-energy radiation, very low frequency radio waves and magnetic field. It also was going to serve as a test portion of the lunar module, and transmit a crude television picture.

Atlas will form the first stage of the Vega and Centaur space vehicles. Negotiations of these in India will be used to launch the existing 272-lb. payload because they have the greater payload capability, and another will be made in less than a year. Only a satellite of Atlas size or larger can boost the payload in the moon, so if it is not to be scrapped, another Atlas-able apparently is the only answer.

If the decision is made to go ahead, obtaining another Atlas should be relatively easy, since Convair's Astronautics Division is producing the missiles only at about half capacity. These required to obtain the booster might cause a substantial delay, however.

Space Technology

Third Atlas-Able Lunar Launch May Be Attempted Despite Failures

By Evert Clark

Washington—Possibly renamed last week that the U. S. will try again to send a 372-lb. payload into orbit around the moon using an Able-1 vehicle, although two Able-1s have been lost at a combined cost of some \$12 million and Able is in demand both for military use and for a number of other space programs.

First Able-1 vehicle exploded at Cape Canaveral, Fla., in September (AW Sept. 25, p. 50) following a static test of its AJD-10A engine. A second Able-1, a second vehicle fired May 26, apparently because a 10-ft. glass fiber insulation around the payload gave way uneventfully.

No backup vehicle existed as of late week, but a backup payload is ready for firing on May 27 when a vehicle becomes available. The last payload and its backup cost an estimated \$2 million to design and fabricate.

Whether another attempt will be made soon depends to a great extent on what government officials call "the prestige factor"—the degree of urgency attached to the mission in view of Soviet success in space.

Service Launches

Exploration of the first Able-1 orbital vehicle Soviet Premier Nikolai Khrushchev was visiting the U. S. It was broadcast by interested Soviet launching of a lunar impact vehicle and a vehicle which photographed the moon's far side and went into an earth orbit.

Once completed, the beginning of space exploration will be approximately 5,600°F. The great expansion caused by the heat exchange as the hydrogen passes through the cooling jacket continues the operation of the pumping cycle.

The XLR-115 cycle also allows fuel tank pressure to be lower than in conventional systems, permitting the use of lighter tanks.

Charles T. Radke, general manager of the center, says this work has shown that there is no technical obstacle that

ARPA Backs Solid Propellant Research

Washington — Advanced Research Projects Agency plans to increase the funding and scope of solid-propellant research at the ARPA program goes into its second year.

Contract, the first of which was awarded a year ago (AW, Nov. 3, 1958, p. 54), is aimed at the development of high-energy, solid rocket propellants which reportedly would have specific impulse of approximately 140 sec. At ARPA, the \$4 contract is an annual research contract.

Four of these contracts—the largest—were for integrated research on complete solid propellants. The other 50 were for supporting research in these five fields: propellant performance, age resistance, nozzles, ingradient research, high temperature research and basic research.

Funding for the four integrated research contracts last year totaled \$6 million, this year it will be boosted to approximately \$6.5 million. Contracts are: Avco Research and Engineering Co., Dow Chemical Co., Minnesota Mining and Manufacturing Co., and American Cyanamid. ARPA has authorized its intention of 40 four-year contracts. A total research budget is expected out for ARPA by the end of the year.

Funding for the second year of the Dow contract, which is the only one of the four actually in the negotiating stage, has been authorized at \$2,250,000. This, which was awarded a \$4,364,000 contract to ARPA last year, will receive \$1,722,000 for its work for the forthcoming year.

Minnesota Mining, whose contract is up for several parts, will get \$3.514,000, and American Cyanamid will receive \$3.5 million.

ARPA's solid-propellant contractors maintain close liaison and are kept up to date on each other's progress. The four companies holding the integrated contracts, for example, meet formally each quarter. ARPA and the three firms are represented at these meetings. In

addition, contractors get together frequently on an informal basis.

Having started at essentially the same base line, the four holders of the integrated ARPA research contracts today stand at roughly the same progress mark.

No ARPA contractor has come up with a new compound. This is expected to take another year or two and there is some disagreement over what the expected compound will be when it is developed. Some contractors believe it is basic black, to turn out to be a high-energy, storable liquid propellant than the high-energy solid originally sought (AW Nov. 30, p. 23). A high-energy monoglycolalate, according to others, also is a possibility.

Whatever it proves to be, the new propellant is expected to make use of fluorine as the oxidizing element. While it is possible to increase the energy level of all solid-propellant combustions, most of the current research is being concentrated on the oxidizer because the oxidizer accounts for the largest percentage of the total propellant. ARPA's concentration for this improvement is that the propellant should have overall improvements in research, development, and production.

Not far off one's mind is the fact that the ARPA contractors in this area are earnestly trying to get fluorine to do the oxidizing job. This means, at the same time, energetic oxidizing element and able—but only in a gas or energetic liquid. When combined in a solid state, fluorine at present becomes one of the most energetic materials in existence. This is the reason some ARPA contractors believe the program is basic black, to render in a liquid propellant than the integrated solid.

Right off the top of the cerebral outcome of contractors and ARPA, agreement agree that the route to an oxygen propellant and possibly an interaction of the propellant. During the past year, the four companies holding the integrated ARPA research contracts have concentrated on defining the type of atom, determining which which types of compounds looked most promising. Now that they know what to make, they are trying to develop methods for them.

In another year, some contractors say, they could conceivably have a new solid propellant compound. Then they will have to scale up output—from 1-ton to 100-ton quantities—to get enough propellant to test. Then they will end with the successful testing of a small quantity of a new solid propellant. As presently planned, it will not be up to the current ARPA contractors to prove that their new propellants can be produced in large quantities or that they will perform well in full-scale rockets.

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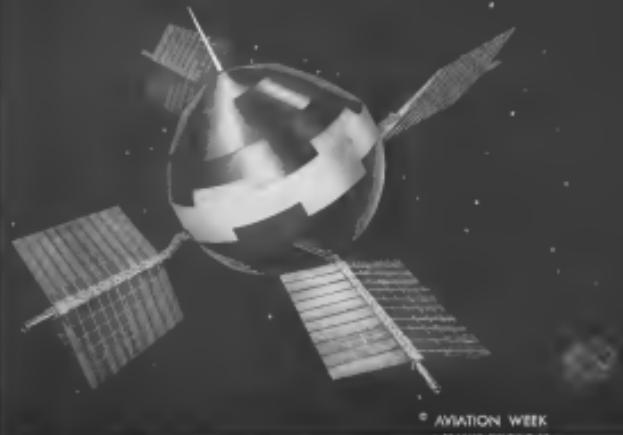
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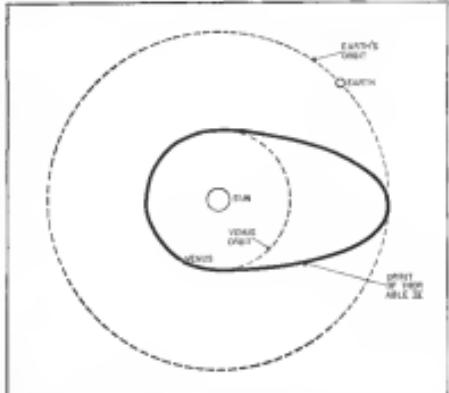
AVIATION WEEK

PHOTO BY PAULING CO.

The Thor-Able IV interplanetary probe will travel around the sun with "puff-tail" antenna extended for trapping solar energy.

First Details of Thor-Able IV Solar Satellite

National Aeronautics and Space Administration's Thor-Able IV interplanetary probe, projected for launch about Dec. 15 into a trajectory which will make it a satellite of the sun, has been approved by NASA Headquarters, and will weigh 10.99 lb. Like Explorer VI earth satellite, it will carry four "puff-tail" fixed solar energy cells. Thor Able IV will not use Explorer VI's "spinnable probe" such as used to control the pivoted antenna for penumbral (see p. 53) but will use a simple, point pattern scheme on the surface to maintain an overall temperature value between 50°F and 500°F. Because it will come so much closer to the sun during its elliptical orbit than did Explorer VI, it is felt that the puffed-out solar cells also will have to incorporate a heat protection scheme. Space phenomena will be encountered on 375-21 as soon as the probe is in the tracking station, according to the NASA management. At 100,000 miles, the Thor-Able IV will be 100 miles above satellite minimum compared to an Explorer VI's 161,000-second stage and Alouette Satellite Laboratory's X-24A1 third stage and Space Technology Laboratories, which is building and integrating the instrumented puffed-out probe. Weight limitations dictate that only one transistors and a few resistors components can be used. Thor's first stage carries as payload, only an autoroll, and first and third stages carry no tracking instruments.



Satellite will orbit the sun in an elliptical path, with closest approach to the sun in the vicinity of the orbital path of Venus, and its greatest distance from the sun in vicinity of the orbital path of earth. Perihelion will be about 67 million miles and aphelion about 95 million miles. Sun orbit will be about 300 days.

NASA Budget

Washington—National Aeronautics and Space Administration will ask Congress for "something under a billion dollars total" for its Fiscal 1961 budget, Associate Administrator Richard E. Blumer said last week.

A supplemental request for Fiscal 1960 also was still being considered last week. A major consideration is both a supplemental and the Fiscal 1961 budget will be the cost of continuing the Sun Surveyor program.

Blumer and the 1961 request will be between \$400 million and \$500 million, he said. The annual Sun Surveyor cost, now \$100 million, is expected to be approximately \$100 million (AW Nov. 16, p. 25). There has been spending recently that the Fiscal 1961 request might go as high as \$182.2 billion. Blumer's comment leaves open the possibility that a supplemental Fiscal 1960 request plus the Fiscal 1961 request of less than \$1 billion might produce a total in the neighborhood of \$1.2 billion.

In addition, ARPA's research, unpaid, is a supporting solid-propellant research contract with Jet Propulsion Laboratory. Contract is for research in non-destructive testing and is funded "at the \$1 million level." ARPA cur-

McElroy Outlines Airborne Alert Plans

By Craig Lewis

Washington—Neil H. McElroy outlined a composite strategic defense concept for the Air Force, which could include a B-52 alert force, the latest he said to the Defense Department last week, to return to peacetime military.

McElroy revealed that the program is currently being laid for an airborne alert capability during the critical 1961-62 missile gap period so that it will be available in case the Joint Chiefs of Staff decide such an alert is needed to show U.S. deterrent power during the years the Soviet Union has superior missile power. Funds have been allocated for research and equipment needed to make an airborne alert feasible.

McElroy discussed the U.S. strategic deterrent except for the missile gap period at a press conference held shortly before the White House. He had been a long-espoused pragmatist and after the President's speech, added, "McElroy the Model of Pragmatism." The former Defense Secretary left the Pentagon the same day his pragmatism was announced, and he is scheduled to return to Pacer & Gamble today, to become chairman of the board after two years and two months in the Pentagon.

McElroy was replaced last week by Curtis E. Cato, former deputy

secretary of defense. Cato, 53, a Philadelphia lawyer, has served in the Senate since 1957. He became undersecretary of the Navy in 1957 and later moved up as Navy secretary. He replaced the late Donald Quarles as defense secretary last summer.

McElroy's Air Force managers plan to complete preparation of the military budget for fiscal 1961. McElroy said the budget went to the White House for presentation to Congress in December. The total U.S. defense spending plan is the \$43 billion level. The total military budget, however, will be set to \$41 billion next year since foreign military aid will be included for the first time.

Although he refused to discuss budget details, McElroy confirmed that the Army Nike Zeus and ICBM systems will not go into production during fiscal 1961 but will continue with a development support program. Other effects of the fiscal budget decisions begin to become apparent last week when USAF used its B-50 program (line page 26) McElroy, and the Joint Chiefs have discussed the present adequacy of the budget, but they will not be asked to sign a letter endorsing it this year. They were required to do last year (AW Mar. 14, p. 29).

McElroy says the U.S. strategic defense capability is substantially higher

than it was two years ago and that the United States capability has been augmented, primarily through deployment of intercontinental nuclear weapons. The acting Defense Secretary reported his earlier forecast that the U.S. and the Soviet Union would each have about 10 intercontinental ballistic missile operational by the end of 1959. He said that, if "this kind of alert" could be built and if we build what we intend to build," Soviet missile capability will be superior to the 1958-61 period.

To counter this missile gap, the U.S. plans to maintain a composite deterrent force until Minuteman becomes operational in 1963. The basic force of the Strategic Air Command is a key element in this composite force. Missiles and, perhaps, aircraft are being considered to maintain an airborne alert to keep part of the B-52 force from diversion on the ground.

Alert preparation involves training of an crews and procurement of long lead-time items, such as engines, so that the crews will be ready and the equipment in storage if the Joint Chiefs of Staff decide such an alert is necessary. Some funds are available in the current budget for this preparation, and more money is allotted in the fiscal 1963 budget.

McElroy pointed out that the life of the B-52 will be extended by the North American Heron Dog missile. This 500-mi-range missile carries a 2000-lb warhead and can be launched from the B-52C and B-52H aircraft. The missile can be deployed, refueled and then used in low-level penetration of enemy territories. McElroy said the Heron Dog does not interfere with the bomb carriage capacity of the B-52.

Discussing U.S. missile capability, McElroy said, "Today we are satisfied that the Convair Atlas is a proved weapon and are moving ahead right now to deploy them." He also said "it is intended that Titan will follow in the process." The Polaris fleet ballistic missile submarine force was mentioned as another part of the composite deterrent force, and McElroy said the submarines will go on station at the rate of about one out every four months, and the Polaris force will be operational by late next year. He said the scheduled Polaris buildup will continue as the force is used as we can set."

While he described current ICBM as an important deterrent element, McElroy was cautious against overstating the benefit of intercontinental weapons that might be quickly superseded by improved second-generation missiles. He also plans obvious, deep holes on successful development of Minuteman and McElroy said the program is "re-

turning" Martini's trend out of the missile business (AW Mar. 9, p. 29). Dividend on common stock was increased from 193.300 shares to 183.700 shares, equal to 16.5% of total common outstanding.

Skinner Aircraft's turbine-powered amphibian S-62 gyrostatute helicopter was tested over during a simulated automobile which drove leading on the Housatonic River, adjacent to the company's Stratford, Conn., plant. No accidents were sustained by the crew. Helicopter, which looks like a two forward of tail piston (part of which will run seaward out of water), suffered water and mud damage to its interior but is a total loss.

Aleatory Aircraft Martin 202 matched last week into a membrane near Williamson, Tex., during an approach to landing, killing all passengers and crew members aboard. The aircraft was originally intended to be a personal aircraft. According to observers at the airport, the aircraft made its initial approach during a light snow and decided to land up for a second approach which brought it over the powerlines and wings into Williamson. It was during this maneuver that the accident occurred.

British government last week decided to sell 17 Hawker Hunter jet fighters to Cuba (AW Oct. 5, p. 15), as part of Britain's policy to restrict sale of arms to the Caribbean area. Cuba wanted to trade Hawker Sea Furies for the jets.

Air Force accepted the first operational Convair B-58 last week for the Strategic Air Command inventory. The first aircraft accepted was the 31st B-58 built and is an improved version of the earlier test model. First 33 B-58s went into flight test program, and 13 of them will be converted to operational configuration and go into operational service.

Hiller X-18 VTOL has made its first flight at Edwards AFB, Calif., with therib-wing fixed in a non-biplane position (AW Mar. 16, p. 38). Flight lasted 22 min.

USAF-General Electric Co. experienced some initial difficulty obtaining the first order from Space (AW Mar. 23, p. 23) failed last week when a GE nose cone carrying a 16-mm color camera and housed by a USAF Douglas Thor was not recovered.

Korean Aircraft Corp. will attempt to land the Soviet Il-14 cargo aircraft, which was downed in the South Korea last week, to handle logistic problems.

President's Advanced Planning Views

Washington—President Eisenhower last week outlined his views of the need for research and advanced weapons planning in reply to a question at a press conference on the eve of his departure to Europe. Following are the questions and the President's reply:

• **Charles H. Niles, Times reporter:** "Mr. President, this is a moment in history in which we have to maintain a long strategic capability in missile aircraft and, at the same time, prepare for the increasingly expensive development of missile capability."

"And I wonder if you could discuss and explain to us how, in such a situation as history, the defense budget does not need to rise but can stay relatively stable over a period of two or three years?"

• **The President:** "Well, I think that the first thing is that—

"Since you are going into new defense systems, largely, to another, particularly in this matter of defense, there is an old saying—what is it?—that the first by which the new is tried, can get the last to be let go."

"Now, that's what we're doing. But we are, if you want to have a real, really expensive thing, stop everything now that we've been doing and then just put a tremendous budget up along the lines of getting something new."

"Now you will really have, to my mind, a bad answer and an expensive answer. But as we are finding, that one Airlift is operational, and is operational, and it comes at that price, it is only natural that there is a desire for expansion and not in the matter of developing newer and better and higher weapons, faster, higher speed, and so on."

"Now, we do not spot that entirely. As I leave, the B-58, on a moderate program, is to be completed, and there is a very definite, there is an R&D program going on now that's even longer (approximately the B-70, see p. 26), so that we do not feel ourselves within a matter of two or three or four years completely dependent upon the missile, until we've got the whole system preferred to the point where we think that the deterrent itself needs nothing else."

driving optimism funding" and the solid fuel missiles are expected to be in place in the calendar year 1963.

Although the composite delivery force is generally discussed as a means of filling the 1961-62 missile gap until Minuteman is operational, McElroy said that "we do not plan at this time to depend only on the Minuteman cities." He said he thinks the booster will be in the inventory "for quite some time to come."

British Industry Resists Group Edict

London—British aircraft industry is resisting pressure to agree upon and the government defines its future policy, outlines its strategic requirements and decides the scale of air British participation in supersonic aircraft and space programs.

The opinion still is widely held among leading companies that when it possesses this information, the industry should be left to decide a structure for itself, without government pressure.

Reliable sources maintain that the Minister of Aviation Duncan Sandys, as a recent flattening out of major aircraft companies, is proposing a 55% reduction of the private industry of 150,000 workers, based on three major aircraft groups and two engine companies.

Envisaged by the Minister as the

new groups were English Electric, Vickers and Hawker Siddeley, Bristol, and a consolidation of the Avro group (the Hawker, Hunting and Folland). All other companies were expected to be absorbed later by these groups.

Resisting is divided by the industry for a wide range of reasons and is being pressed to bear. Sandys is reported to have stopped the issuance of contracts to minor engineers and some reorganization has been agreed. According to one source, a measure affected by the new grouping is the Royal Radar Arm, others could be the Hawker.

De Havilland is not anxious to close the Avro halo because parts of the Avro 121 suffice, both Hunting and de Havilland have completed and design for jet fighter aircraft. The merger between Bristol and Hawker Siddeley appears to be thwarted by financial factors associated with each.

Companies most hostile to any reorganization were Handley Page and Blackburn and General Aircraft Co., which probably accounts for their resistance from the three-group structure.

News Digest

Martin Co. last week reported additional purchase of stock of General Precision Equipment Corp., adding to the more than 10% of General Precision stock acquired this summer, and

Jets Spur Transatlantic Passenger Rise

Airlines foresee one-third increase in seats next season, as 12 carriers phase jets into service.

By Glenn Garrison

New York—Airline capacity on the North Atlantic, which rose little last summer in wait carriers waited for their jets, is expected to increase by about one-third next season when 12 airlines will be offering jet service.

Most carriers reported good results for the 1959 peak season although many were holding the line in wait capacity, as predicted by AVIATION WEEK (July 4, p. 46). Scheduled International Air Transport Area airlines offered 936,973 seats on the route during the June-through-September period, an increase of 4% over the same period of 1958.

Passenger counts totaled 893,976, an increase of 12%. By way of contrast, capacity increased 43% in the summer of 1958 over the summer of 1957 and the passenger increase was 15%. Many carriers in 1958 were adding new seats of their long-haul jet planes 8065.

For the first nine months of 1959, the passenger total was up 13% to 1,091,758, topping the earlier jet season for the first time so far in the year. Capacity for the first nine months rose 5% to 1,036,505 seats. Overall passenger load factor for the four-month summer period of 1959 was 78%, up from 65% for the first nine months.

International passengers earned in the 1959 summer season totaled 121,457. The economy class total was 548,169 and the remaining transatlantic tourist class passengers accounted for 26,350 occupied seats.

Transitional Period

Only Pan American World Airlines and British Overseas Airways Corp. had jets in their transatlantic fleets during the entire summer 1959 period, but only long of the 16 IATA airlines on the route will lack jets next summer. Most of the new Douglas DC-8s and Boeing 707-320s and 338s will begin appearing on service next spring. Jets will dominate the North Atlantic next summer, and the carriers have this transitional period with some uncertainties.

* **PAN AMERICAN.** While its 10 Douglas

and Avro 748 aircraft in the fleet may total 1,274,000 seats next summer, Pan Am will cut its transatlantic competitive rate efforts to find the market. Bidding prospects on high rates of the Atlantic is a healthy one. The jets themselves, with their new standards of comfortable flight and their non-stop speeds, should dominate air travel of the future. But whether all carriers will be able to keep their expensive new jets

for the June-through-September 1960 period and tentative outlook for 1960-61.

* **PAN AMERICAN** achieved a spectacular load factor of 86% for the period, running its capacity to 95% and yet carrying 14% more passengers than during the same four months of 1958. Load factor for the 1958 period was 69%. Seats offered in the 1959 period totaled 104,199, up 74,747 eastbound and 74,622 westbound. Passengers totaled 128,758-62,672 eastbound and 60,096 westbound. The airline offered 55% of its seats in Boeing 707-220 jet equipment during the period. Next summer, Pan American expects to increase its capacity to 15% of its seats, with some carrier improvements about 50% of the total. The carrier plans to operate 40-45 transatlantic round trips a week at the peak of summer 1960, exclusive of the West Coast-Europe polar route. Its Boeing 707-320s, already planned for the North Atlantic operation as well as on other routes, will probably be incorporated to offer jet equipment aboard Douglas DC-8s from National Airlines under Pan American's and National's reciprocal agreement, and/or Pan American's own DC-8s, which will start arriving next year, plus assignments to the carrier's division. Pan American's estimate of the market expansion for 1960 is 15%.

* **BOAC.** The carrier's 10 aircraft, which since 1958 have been hard to get, will be significantly more numerous than a year ago. The airline believes next summer's traffic will parallel a demand for passenger as well as jet seats. Pan American's DC-8s in a typical configuration, will seat 16 first class and 87 economy passengers, a total of 123.

* **BOAC** took a different course from Pan American's last summer, increasing capacity by 53% and carrying 47% more passengers for a total of 162,921 seats and 112,617 passengers during the period. Figures indicate BOAC's transatlantic operations from Canada last factor was 69%, a figure down 7% during the same 1958 period. The British carrier provided 10% of its capacity in the transatlantic Boeing 707s and the Boeing 747-200. The Consolines were used in the last and first class and first and economy configurations, with senior and economy passengers carried in the other equipment. Load factor for the period was "slightly under 90%." BOAC said First-class passengers in all equipment for the period totaled 20,355 and first-class seats totaled 34,965, for a first



First Lufthansa Boeing 707-420 Rolls Out

First Boeing 707-420 International jet transport for Lufthansa German Airlines is rolled out from the Boeing Airplane Co. plant at Renton, Wash. Airbus has ordered four Intercontinentals, plus two will make its first flight this month and will be delivered late in January. Powerplants are four Rolls-Royce Conway bypass engines.

class load factor of 69%. Although first-class seats had dropped from 100% to 60% and then 40% in the last summer, the BOAC offered 39,362 seats in this class, carried 18,482 tourist passengers. Economy capacity was 95,956 seats and passengers totaled 69,910. BOAC plans to offer about 40% more peak capacity next summer than during the peak of 1959.

In July, Pan American will phase out Boeing 707-420s will be phased onto the route beginning next January, and Conair will be phased off the route with a mix of the Boeing jet transport managers.

Planning Outlook

Outlook, for filling the scheduled capacity is "precarious" in BOAC's view, and the carrier already has bookings which indicate a 50% increase in charter business during the winter. Charter will be flown in all types of equipment including the new jets.

Tours World Airlines, which has just inaugurated its first transatlantic jet service with Boeing 707-320s (AW No. 16, p. 41), cut back its summer 1959 capacity to 307,000 seats, up from 333,278 the previous summer. Passengers totaled 76,561, down from 87,729 during the same period of 1958. Minimum of TWA's transatlantic fleet will be aircraft, the Lockheed 1649A Constellation. During the period July 3 through Sept. 30 of 1959, TWA offers 66 seats on round trips a week.

Next summer, the airline expects a peak of only 40,000 round trips on the North Atlantic, but 35 of them will be in the big jets and peak world capacity is expected to total 11,790 seats in both directions, compared with

6,922 seats last summer. The other four round trips will be flown in 707-220s and these aircraft also will connect with the jets at overseas gateways. TWA forecasts a passenger increase of 50% for the next 1960.

KLM Increase

KLM Royal Dutch Airlines increased its traffic by 21% to 61,977 passengers in 1958. Its capacity went up 15% to 91,286 seats. The carrier expects a 15% increase in both seats and traffic next summer. First transatlantic jet service with DC-8s is planned April 1 with a direct nonstop trip between New York and Amsterdam.

From June 3 on, KLM expects to schedule two daily DC-8 flights and two daily DC-7 flights, the latter carrying economy and first class seats and business. The carrier has one of four fifth place in transatlantic passenger volume to Heathrow, on the basis of summer 1959 figures.

Scandinavian Airlines System, which has just inaugurated its first transatlantic jet service with Boeing 707-320s (AW No. 16, p. 41), cut back its summer 1959 capacity to 307,000 seats, up from 333,278 the previous summer. Passengers totaled 76,561, down from 87,729 during the same period of 1958. Minimum of SAS' transatlantic fleet will be aircraft, the Lockheed 1649A Constellation. During the period July 3 through Sept. 30 of 1959, SAS offers 66 seats on round trips a week.

The Scandinavian carrier plans to make the most of its 80 Consolines with its transatlantic fleet. DC-8s. With this equipment combination and Air France now has its Convair flying capacity in order of 24 to be completed by the end of next year. Not long after, the carrier plans to be serving 80 cities with its jets, 82 with the Convair and 39 with the 707s.

Lufthansa German Airlines boosted summer 1959 capacity in 24% over the previous season, carried 21% more passengers. Totals were 47,076 seats

seats to make an DC-7C flight profitable.

It will start placing jets onto the Atlantic in April and expects its piston services to end around the middle of next September.

In July, SAS may be offering 18 weekly jet and seven weekly piston schedules.

Air France offered 69,361 seats, up 10% from the 1958 period. Traffic increased 17% to 50,084 passengers. Of the 1959 capacity, 57,621 were in economy seating. The airline estimates a capacity increase next season of 65%. Boeing 707-320s are now scheduled to leave from New York Jan. 25 with daily flights, and to nose summer peak flight services with three weekly flight flights.

At April 1, jet schedules will be the polar route from Los Angeles via Montreal and Chicago will be served by April 15. At that time, all of Air France's transatlantic services will be beamed.

The carrier's 320s will carry 32 economy and 100 economy passengers.

Head Full

Other jet plans include Pan American's Tokyo service beginning Feb. 2 with the 120. Lufthansa, Air France will add its Boeing 747s to its transatlantic fleet. Air France now has its Convair flying capacity in order of 24 to be completed by the end of next year. Not long after, the carrier plans to be serving 80 cities with its jets, 82 with the Convair and 39 with the 707s.

Lufthansa German Airlines boosted summer 1959 capacity in 24% over the previous season, carried 21% more passengers. Totals were 47,076 seats

and 31,661 passengers during the 1959 period. Luftfahrt's last Boeing 707-420 is scheduled to go into transatlantic service Aug. 1 from New York and Chicago, and polar jet service from San Francisco beginning May 30.

The airline will have three of the big jets in operation next summer and four next fall. It plans to operate three weekly flights out of Chicago, seven of New York and two out of San Francisco from the pole, and a total flights with 16,000 passengers when revenue begins.

Canadian Airways World Airlines can book capacity 117 flights a week and expand the service because of a special agreement with the Brussels Taxis. Some during the 1959 period totaled 51,518 and 25,900 passengers were carried, a drop of 18% from the previous summer. Sabena's 707-300s are scheduled to appear in North Atlantic service Feb. 15 with four weekly round trips, which will be supplemented by three weekly DC-7C flights. The airline expects to schedule 14 weekly jet flights at the port.

Sabena will step up its transatlantic capacity dramatically as its DC-8s begin phasing in, with first seats tentatively scheduled for May 6 with three weekly New York-Munich schedules. At 12 weekly schedules, as planned for next year, when the airline's three plane fleet has been delivered.

Sabena will be the third carrier to be transatlantic jet in with its own Convair jet schedules (IAW Nos. 23, p. 43). During the intermediate period of 1959, Swissair's transports were up only slightly to 35,531 seats, compared with 27,942 during the 1958 period. Passenger total rose from 10,463 to 11,747.

Trans-Carri Air Lines plans to put its Convair-powered DC-8 on transcontinental domestic service May 1 and

to offer IEC 8 service on the North Atlantic beginning Aug. 1. Last summer the airline offered 35,533 seats and carried 30,699 passengers for a load factor of 85%. Totals for the 1958 period were 17,010 seats, 20,245 passengers, load factor 70%.

Qantas Empire Airways introduced transatlantic Boeing 707-120 jet service in September as part of its new round-the-world jet service. With two weekly round trips and no originating base on the Atlantic shores, Qantas carries a very small percentage of the transatlantic traffic. If frequencies are stepped up next year, the jet will still be a part of the global network.

Four of the 16 IATA airlines on the North Atlantic will have new routes without jet equipment. Irish Air Lines, which entered the transatlantic picture in May 1958, with leased Lockheed 104-901 equipment, expects delivery of its first Lockheed Boeing 720 next fall. In the meantime, it will continue to offer an all-economy service on the new route.

Canadian Pacific Airlines, which has been flying Britannias four times a week from Vancouver, B. C., to Anchorage and DC-6Bs from Montreal to Santa Maria, Lisbon and Madrid, has no jet route. Convair-powered DC-8s and its partner the first British in December 1960. During the winter, Canadian Pacific will plan some short-haul services in a north-south route to Rome, with first schedules set for May 1. Britannia will be at Rome, which is an extension from Lisbon.

Trans Aviacion de Spain has ordered three DC-8s and hopes to get the first in late 1960. The carrier operated four weekly Lockheed Super C Constellation flights on the North Atlantic last summer, as it did in 1958. It plans no increase next year but is stopping up jet-powered and adds plans to prepare

for transatlantic jet service by the fall.

• **Identify, locate, measure and determine characteristics of transoceanic flights.**

Phase I of the program has been completed and work on Phase II is well under way, according to Flying Tiger. Initiated in Phase II are studies of value volume movement, weight, dimension, traffic, density, origin and destination, chronological movement and distribution costs of potential air cargo.

For several months, Flying Tiger has had a research staff working under the direction of Robert L. Bremner, manager of the airline's sales and tariff department. Keith A. Miller, manager of Canada's sales research staff, will join Bremner for the study. Stanley Brown, professor of transportation for the University of Washington, and Roger E. Olson, professor of transportation for the University of California at Los Angeles, have been retained to consult on



Boeing 720 Medium-Range Jet Makes First Flight

Boeing 720 medium-range jet transport (AWW No. 16, p. 40), making its first flight from Renton Municipal Airport, Wash., is the first of 32 for United Air Lines. Aircraft is powered by four Pratt & Whitney JT3C-7 engines, each developing 12,000 lb-thrust. Aircraft will be delivered to United next April. 25 have been ordered by American Airlines and three to Pan Am. Aircraft is 84 ft. 4 in. diameter. 707-120 and 41,000 lb. lighter, leading edge of the wing has been extended to increase sweep between the leading and trailing edge and add to leveraged wing lift.

ICAO Studying Traffic Data Exchange

By Fred Eastman

Washington—International airline long-haul conferences over the exchange of passenger originations and destination reports is heading to a climax with a concerted effort to bridge one of the widest gaps in world airline schedules.

A move to try and solve the problem is being undertaken through the Inter-Union Civil Aviation Organization which has appointed an liaison panel to study the feasibility of a multinational organization and destination exchange, review the background of the dispute and submit proposals for a workable agreement. The panel's next meeting is scheduled for May.

Difficult Task

The task of recommending a plan that would be acceptable to all the airlines concerned will be difficult. Flag carriers from the Scandinavian countries, the Netherlands and Belgium are strongly opposed to the exchange, while the other members of the United Kingdom, Brazil and the U.S. are equally strong in their support.

Airlines have exchanged traffic data in the past, but this was abandoned about ten years ago on grounds that they served no useful purpose, at least partly because many carriers failed to

submit directly to all the information requested. The U.S. was one of the nations that voted for discontinuation of the reports.

The type of reports now sought by proponents of the exchange is true origin and destination report based upon the passenger's ticket that would show where he first boarded the aircraft and the route taken to his destination. They, they say, would be advantageous to all airlines in future planning for the establishment of sales offices, flight frequency schedules and routes.

Those opposed to the plan argue that such reports would be time consuming and costly and would not be of any help in airline operations. However, these carriers did indicate that they would agree to furnish reports on the number of passengers traveling between their respective countries and other nations, a plan similar to the earlier reports that were submitted.

Some of the foreign carriers opposed to the exchange also have indicated that they might agree to exchange origin and destination reports with the U.S. if, in return, the U.S. would agree to additional route concessions.

This is strongly opposed by most American flag carriers who contend that foreign carriers clearly have access to a greater potential market in the U.S. than U.S. carriers have access in re-

turn. U.S. international carriers are not affected by the granting of additional route concessions. A foreign airline might be induced to support this proposal in order to get an agreement for use of its own network of routes.

Under the ICAO principles, however, this type of bargaining would not be an issue, and any agreement reached would have to be made solely on the merits of the exchange and the ability of the panel members to clear any doubts as to its purpose.

U.S. Belied

U.S. flag carriers contend that the real opposition to the exchange of origin and destination reports based on nations, and not airline members, is that it would mean an increase of the capacity classes incorporated in bilateral air agreements.

The capacity classes in a Bermuda-type agreement provide that the airline members made available to the public by the airline designated to operate between the two countries shall have a close relationship to the requirements of the public for such services. This is termed Third and Fourth Freedom traffic.

At the same time, the Reynolds principles provide that the airlines have a right to embark or disembark international traffic destined for, and coming



First TEAL Electra Makes Delivery Flight

First Model 100C Lockheed Electra (left) being ferried by Tasman Empire Airways Ltd. (TEAL) leaves Bayreuth, Calif., on delivery flight to Auckland, New Zealand. TEAL Electra carries 33 passengers. Plans, one of three Electra ordered, will start service the month, two others will be delivered by year-end.

FIRST AGAIN!



Air France—First European Airline to Fly Giant Boeing 707 Intercontinental Jets Across the Atlantic!

Here's another Air France "first" for the record! Soon Air France's Boeing 707 Intercontinental Jet will touch down at Orly Field after a 6½-hour nonstop flight from New York. This flight will mark the beginning of the world's first "jet-to-jet" service—intercontinental jet nonstop daily to Paris, Caravelle jets from Paris to all Europe, Africa and the Middle East.

Air France is no stranger to the pages of aviation

history. As early as 40 years ago, Lucien Bousquet made the first international commercial flight between France and England. Similar historic first flights include the first crossing of the South Atlantic, the Andes, and the first scheduled Far East service.

The inauguration of transatlantic jet service constitutes the forward steps that have helped make Air France the world's longest airline, with the world's most personal jet service.

From third countries at points on routes specified in the agreement so long as service provided by the local or regional airline in the route is taken into account. This is known as Fifth Freedom traffic and is generally considered a secondary objective in establishing the route, but it is one of the biggest problems confronting international airfares.

More recently, however, a new angle has been injected into the dispute, primarily by European carriers, who are claiming that they have Sixth Freedom traffic. They say, in effect, that traffic that is brought through an airline's routes can move to a second country. For example, a passenger bound for Paris who is boarded in Mexico by Pan American World Airways and takes to New York on route to Paris would be Sixth Freedom from Mexico to New York, according to the European airlines, and the same is Third and Fourth Freedom traffic from New York to Paris. This would permit carriers to reduce the Fifth Freedom clauses restricting the number of passengers that can be carried.

U.S. carriers do not agree with this interpretation. They maintain that traffic originating in the U.S. and bound for France at vice versa is Third and Fourth Freedom traffic for which the U.S. and French carriers can compete. All other traffic not originating in or destined for either of the two countries is Fifth Freedom, they say.

Traffic Flow

The originator and destination reports would record the amount of traffic between the two countries as well as the amount of traffic going to or coming from a third country. U.S. flag carriers say they have long supported that a proper picture of the traffic of some foreign airlines is crossing flags or going to a third country is violation of the carriage clause. U.S. carriers also have been charged with Fifth Freedom traffic violations. Airlines, manufacturers or even management institutes, however, would not accomplish such a violation.

Supporters of the originator and destination report exchange feel that, while the reports would reveal the type

of traffic being carried by airlines, there are a number of more important reasons for an agreement in this issue. One of the biggest problems, these carriers contend, is the lack of understanding of the uses that could be made of the reports.

Disagreements, when airfares and destination reports are exchanged, they are used to support requests for additional services, to serve a pattern of present and future passenger growth and long range costs and service needs. The benefits of an exchange of figures that all international airlines could compete are currently being prepared by a joint industry-government group in a form of a report to be submitted at the May meeting of the ICAO 11th-cabin panel.

U.S. representatives on the ICAO panel is Werner H. Börd, chief of the Office of Commercial and Statistical Services of the Civil Aeronautics Board. Other nations represented on the panel are Argentina, Brazil, Denmark, France, Sweden, the United Kingdom, Spain, the Netherlands, Switzerland and Canada.

707-320s Improve Nonstop Capability

By William H. Groggy

London—Boeing 707-320 series Intercontinental jet transports are crossing the Atlantic westbound nonstop 75.84% of the time and operators expect the aircraft's range capability is not in question on the trips which require a fuel stop.

Below—whether a destination is the prime cause of unscheduled stops. However, a Federal Aviation Agency requirement for increased reliability against oil tank fires for the airplane (AM 100) has not been causing more nonstop sorties and also has affected the nonstop performance.

Nonstop sorties have been established by FAA and the fuel increases are 5-5% instead of the 7% return figure.

Trans World Airlines' Flight 701 which left Paris with a group no return after the inaugural flight to Europe (AM 100, p. 41) was a good example of how the airline will operate the westbound transatlantic route in winter conditions.

Flight 707-321

The airplane, serial No. N741TW and powered by four Pratt & Whitney JT4A-3 turbfans, is the first of the three of TWA's 707-321s delivered so far. It carried 75 first class passengers, 98 economy, three pilots, flight engineer, steward, three purser and two stewardesses.

Because the length of the transatlantic

runway 36L at London Airport is only 9,176 ft. and because of the 1.4% runway speed requirement, the maximum allowable gross weight of the aircraft was reduced from 360,000 lb. to 360,000 lb. at the 400 ft. of the London Control and Terminal Tower the aircraft was cleared to land at 100 ft. on the great circle route to New York, a stop was planned at Gander and the fuel load reduced slightly more than necessary to meet landing weight requirements at Gander without refueling fuel.

Against a total gross weight of 260,027 lb. with a fuel load of 124,600 lb. about 33,000 lb. less than the 140,954 lb. allowable. Since headwinds were forecast to exceed 100 kt. on the great circle route to New York, a stop was planned at Gander and the fuel load reduced slightly more than necessary to meet landing weight requirements at Gander without refueling fuel.

The 45 sec. takeoff required an estimated 7,500 ft. of runway before lift-off. The aircraft was rotated at 135 kt. and the nose was airborne at 164 kt.

Cruise Altitude

Initial cruise altitude was 36,000 ft., later raised to 39,000. The air speed was 470 kt. Actual track selection was about 100 nm east of the great circle course in keeping with the actual wind which would be less than forecast.

The properly burned out altitude, originally planned on the London-Gander stage averaged 495 ft., reducing the average headwind component 67 kt. Since Gander weather was deteriorating and New York and Boston were open, the flight elected to eliminate the Gander stop and continue to New York International Airport at Islip with Boeing in alternate even though increased

headwinds were forecast.

Ground speed dropped to 330-335 kt., indicating a 150 ft. headwind component. So-called reduced power reductions were made, reducing free air speed from 460 ft. to 440 ft. The aircraft and fuel weight to 360,000 lb. at which the aircraft was cleared to land at 100 ft. and 16,000 lb. fuel aboard at Islip.

The flight landed with 10,000-11,000 lb. fuel aboard at Islip in 8 kt. 17 min. from London—takeoff to touchdown.

Fuel Stop

In its first week of 330 operations, one of TWA's three nonstop transatlantic flights stopped at Gander for fuel. This flight, the first one westbound with the larger airplane, met the combination of headwind caused by weather and the account of using Pittsburgh as an alternate, which would have required fuel on board at New York of 34,000 lb.

In contrast, the first eastbound flight from Islip to Paris took 331 min. total off from Islip and 294,000 lb. gross and about 127,000 lb. fuel, a 9,800 ft. takeoff using 5,400 ft. of runway 17's 11,500 ft. The aircraft cruised at 33,000 ft. for the airline's record of 495 nm. TWA, at a ground speed of 535 ft. to New York—London flight time, LaGuardia, took 10,000 lb.

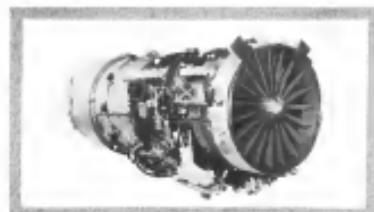
Pan American World Airways, which put the long-range Boeing 747s service first, has been operating its 707-321s in scheduled transatlantic service since

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First Eastern DC-8 Jet Transport Rolled Out

Eastern Air Lines' first Douglas DC-8 jet transport, equipped with Pratt & Whitney JT3 engines, was completed outside the Douglas plant at Long Beach, Calif. The airline plans to put its first DC-8s into service on the New York-Moscow run in mid-January, 1968, to meet jet competition from two other carriers. Eastern does not plan to use water injection with the JT3s.

On 10, Pan American's *sunburst* record.

- **Westerboard**, London-Edinburgh, 17 out of 22 flights nonstop, Farnborough, 15 out of 20 flights nonstop
- **Eastbound**, Edinburgh-London, 21 out of 22 flights nonstop, Edinburgh-Paris 16 out of 15 nonstop

Pan American and the lengthening of the London services by 1961 and the introduction of the 707-320, right on point, should help the statistics in this year. Pan American is operating seven of Osh Field in Paris, whose runway length is 10,600 ft. 8 available.

Though winter winds will undoubtedly not show any improvement-those encountered on the TWA flight were higher than annual for that season-Pan American believes it may benefit as the balance from colder temperatures as far as fuel load is concerned. Next summer might be a problem at London, however.

Pan American says packed羽翼 not weather and use of the early 320 flights carried when reported as a record, just about 30,820 lb. on a nonstop, scheduled flight.

Pan American says it has been able to operate the airplane at maximum temperature, around of Mach .82 with a fuel consumption of 2,100 gph or about the same as the 12,000 lb./hr. noted on the TWA trip. This makes for a London-New York schedule of 7 to 15 nonstop flights, which allows for favorable winds, and Pan American says it has been operating suc-

cessfully within this schedule.

Pan American has 12 of the 321s, six in the Atlantic Division, four in the Pacific and two not assigned and which are used as spares for modifications. The Atlantic airplanes are operating a New York-London and a New York-Frankfurt-Munich schedule.

TWA has 11 of the 321s on order. None will be used in New York-London-Frankfurt and New York-Frankfurt-Sydney schedules. The three others are unassigned now, but might be used as senior to Spain or Greece and beyond.

Non-operating three flights weekly.

TWA and Sir Frank

British newspapers are noting at BOAC for letting Trans World Airlines Sir Frank Whittle Rotors a present to develop one of the turboprop engines. In fact, the first flight of the turboprop engine, the first jet transport flight, Sir Frank was part of TWA on its first London-New York Boeing 707-321 flight.

The Evening Standard and Sir Frank had noted BOAC to be getting on a de Havilland Comet practice flight, but was not. The paper quoted a BOAC spokesman as saying:

"Sir Frank ceased to be our jet engineer in or soon after 1950. I couldn't possibly check if he asked to make a flight before then. And so far as I know he hasn't asked us since."

The paper added:

"As was the way of publicity, TWA didn't wait to be asked."

New York-London-Frankfurt and New York-Frankfurt-TWA will go to daily schedules New York-Paris-Rome Jan 10 and to New York-London-Frankfurt Jan 17. TWA will make available one airplane of that group to Northeast Airlines for use a week, beginning Dec. 17. But unlike the Pan American-National air exchange, the TWA will continue to do so.

Starair schedules call for two daily round trip flights on each of the two routes, beginning Jan 1. A typical schedule calls for Flight 800 to leave Idlewild at 7:30 p.m. and arrive Rome at 10:15 the following morning (time Rome). The flight turns around at Flight 801, leaves Rome at 2:15 p.m. and is scheduled to arrive Idlewild at 5:10 p.m.

Following the schedule on the Northeast lines will not cause any clear training problem. Even with only the four engines TWA will have to run out the four-decked flight schedule on January 1, TWA will have two airplanes leaving over from around one night until departing the next. TWA will give Northeast an airplane for the morning flight, a flight leaving for Rome at 9:30 a.m. and returning at 2:30 p.m.

The London and Frankfurt route will become flight but the Rockies will be used to supplement the Pan routes. The airline reports that its jet transatlantic flights are already booked 55% for next year, indicating next summer may be a big one for transatlantic operations with jet equipment (in, p. 30).

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FAA Sets Pilot Age Limit, Tightens Rules

By Robert H. Cook

Washington—Federal Aviation Agency last week issued a mandate requiring airline pilots to retire at the age of 60 plus six, regulations calling for FAA approval of airline training programs and tighter cockpit qualifications in a move expected to touch off a new round of labor-management disputes that could have far-reaching effects.

These same decisions by the FAA, the airlines and the Air Line Pilots Assn. (ALPA) could become even more intense, depending upon the outcome of a public hearing scheduled by the agency on Jan. 7 on proposed regulations that would limit jet training programs to airline pilots under the age of 55.

FAA's assertions that it formulated the new regulations in an effort to improve flight safety have drawn conflicting responses from both the pilots and management. The airlines agree with the mandatory retirement age, while jet pilot with ALPA is opposing the proposed jet training age restriction as having little bearing on safety and as being too costly to implement. At the same time, the pilots' union is backing FAA's stand on training regulations, which it has sought for some time, and disagrees with company contentions that that move is too costly and unnecessary in the interest of safety.

As enunciated by the Federal Aviation Agency, the new regulations require these measures:

- Establishment of age 60 as the mandatory retirement age for airline pilots; effective next May 1.
- Approval of all airline training programs in U.S.A.
- Mine comprehensive training for airline cockpit.
- Podiatry checks for cockpit every 12 months under the direction of either a pilot or a designated company check pilot.

Training regulations will become effective on Jan. 1, 1967, in order to provide the maximum sufficient time to obtain approval of these training programs and to qualify cockpit under the new regulations. Airlines must make their training programs for cockpit approved in next 12 months.

Admiration of the automatic retirement age brought a sharp world protest from ALPA which, in its efforts to challenge the ruling in the federal court by asking an immediate injunction against the action, which is termed part of the "crown" powers of the FAA. An ALPA spokesman also said the extent of the agency's authority to issue such rulings should be

interpreted and defined by the next session of Congress.

Attacking the age regulations as "absurd and capricious," ALPA asserted earlier claims that there is no medical basis for such action and charged that FAA had refused to permit the pilots' union to examine the evidence upon which the regulations was formulated and also had refused to hold a public hearing on the matter.

ALPA and the "dissident" age had been "picked out of a hat," had no bearing on flight safety and is "arbitrary, unscientific, ridiculous" program. The union claimed that the FAA's stand is "arbitrary at odds" with the overall philosophy of government studies on the relationship between age and ability. ALPA said this opinion also has been expressed in letters it has received from several masters and compasses, who, the union said, indicated that the FAA plan is unusual and contrary to public policies.

Wage Demands

Industrie claims before final enactment of all the new regulations, plus the proposed mandatory age limitation, a short time to trigger a new series of wage demands by the pilots who estimate that members will lose earnings and fringe benefits of \$200,000 a year from the age限制 on jet training. Combined with possible earnings decreases for a lowering of monthly flight hours, which would require more flight personnel, the total cost of these pilot's base salaries and increased training costs, the group of regulations could result in a demand for additional fare increases by the carriers who are now awaiting a final decision from the Civil Aeronautics Board on the General Passenger Fare Investigation. The airlines are training costs will jump by \$28 million per year.

Because of the retirement age regulation, the Federal Aviation Agency said, it based upon medical finds that sudden incapacitation due primarily to heart attacks and stroke become increasingly more frequent in age groups approaching 60 and cannot be predicted on an individual basis by prior medical examinations.

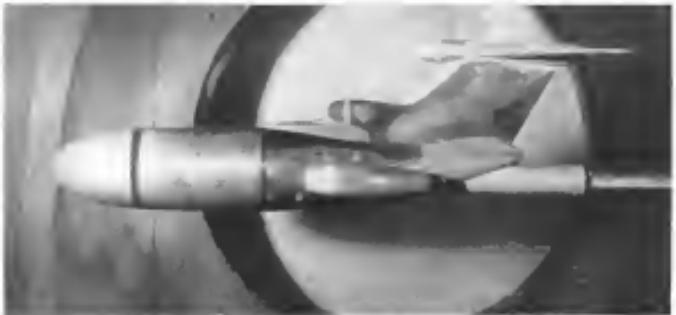
While it has not been proven that age is a factor in air carrier accidents, the agency said these are now only 40 percent of all air accidents in the carriers. This number, however, could be expected to grow to 70% in 1967, with airline accidents showing a growing number of jet operations in the hands of the older pilots. FAA believes that because of the medical facts already known which indicate a pattern of decreasing mental and physical ability with age, permitting pilots over 60 to remain in command of an aircraft carrying up to 500 passengers at speeds of 500 mph would be a hazard to air safety.

Operation of new jet aircraft has boosted the average age of jet pilots to a point considerably higher than that for the over all airline pilot group. High performance of the aircraft, coupled with their greater passenger capacity, the agency says, makes jet operations more hazardous than those of greater responsibility on the pilot.

Based on its present knowledge, FAA made the following statement to support the 60 year retirement age:

- Increasing frequency of possibility of heart attacks and strokes after the age of 40 indicates that 24 of over 3,000 pilots over the age of 55 can be expected to suffer this each year.
- Pilots aged 55 or over required twice as long to qualify on the Boeing 707 jet transports as compared with those under 40 despite their greater experience. Those under 40 averaged about 15 hr., while pilots 55 to 59 averaged 35 hr., with some requiring as many as 40 hr.
- Foreign air carriers already have established comparable retirement ages at well as age limits for jet transportation. British Overseas Airways Corp., KLM Royal Dutch Airlines and Pan American Airways at 55; SAS requires a 60-year retirement age; Air France, the U.I. Pilots' Assn. at 57, and considers a retirement age of 55. Age limit for jet transportation is 57 for BOAC, 46 for KLM, 47 for SAS and 55 for SAS.

• Aircraft manufacturers and retailers other than airlines have no pilots over 60 and only two over 55 while a sample of 25 of the largest aviation business organizations which now employ pilots shows that less than one over 54, and companies which build commercial aircraft report that their oldest service pilot is 49. While the new regulations for jet carrier training program and cockpit qualifications "will result in additional costs" to the airlines, FAA concluded that the extra expenses are "far exceeded" in the considerations of such involved. The regulations is considered necessary, FAA said, because although airline previously had full control over their training programs subject to TWA inspection and many had excellent records, others failed to achieve the minimum safety objectives taught by the training requirements of the Civil Air Regulations. Airlines will now be required to submit such programs for FAA approval and seek approval of any subsequent changes.



PLACEMENT of de Havilland DH-121 turboprop engine pods forward of tail section is shown in this close-up of a wind tunnel.

Area Rule Cuts DH-121 Drag Coefficient

By John Tintall

London—One of the area rule concepts on the test bed of the de Havilland DH-121 transport is wind tunnel tests at Hatfield has dropped the drag coefficient 0.02 in the upper speed range, designers told *Aviation Week*.

Engines, pods, although all of the parameterized cabin structure for static and static torsion, have been placed as

far forward of the fin as possible to achieve a smooth area distribution along the whole length of the fuselage.

A switch to light alloy development models also speeded the test program and cut costs.

In the wing development program for the DH-121, many modified versions of eight different wing configurations were tested in both cruise and landing speed regimes. High speed tests were carried out on a number of model configurations.

Severe Headwind

Lack of throat wind tunnel facilities proved a severe handicap in the original. Consequently, when de Havilland had to develop solely on the much overburdened Royal Aircraft Establishment facilities at Farnborough, this situation remained fixed until the basic design proposal and no testing concurrent with the design program was possible. It was later changed to the wing leading edge being introduced without ground effect tunnel testing which led to the aircraft still configuration associated with the first model of the aircraft.

Different wing configurations based on various combinations of root thickness, sites of change of wing root incidence, and root profiles suggested as three, four, five, six, seven and eight root spanwise locations. Some wings had more than one change of profile at the maximum thickness. As a result of this extensive program de Havilland was able to raise the critical Mach number to 0.675 and reduced the drag coefficient by an amount of



ADDITIONAL complete with engine nacelle, flaps and flight controls undergoes low speed handling tests with the leading edge dropped in 9 ft x 7 ft wind tunnel.

0.014-0.015 over the entire speed range.

The engineering design adopted is regarded by de Havilland as being in line with basic Boeing and Douglas design philosophies and features a well-rounded leading edge to increase the critical Mach number and a thickened root section. Actual details of this section have not been revealed, but the engineers claim to have resolved conflicting aerodynamic and structural problems with better than conventional solutions in each of these two categories.

The company says it has tested an outstanding single wing root structure, easy to make and maintain and which has four main areas that are fatigue-prone.

Leading Edge

The modified leading edge, the subject of recent Boeing designs (AW Nov. 9, p. 42), has been part of the de Havilland thinking since the design was conceived four years ago.

But the faceted root pods are third of the way into the fuselage, according to de Havilland's senior aero dynamics.

The optimum flaring of the nose profile was resolved only by extensive detailed model research work and testing.

Tests on another feature of the DH-121—the hinged, dropped leading edge—concerned the interaction between the nose root and the droop character introduced with the area of the cross to be relieved forward.

With fixed leading instead of cambered tracks, de Havilland claims

that a dropped edge is easier to engineer and design than static, as more reliable because it is simpler and gives nothing aerodynamically. De Havilland's simpler because the arrangement is free of flexible hoses needed to deliver static.

Commenting on the use of light al models, de Havilland considers that besides being quicker and easier to make than steel models, they were much more cost modified. The metal proved fully adequate for development work, which is the opinion of workers at Hatfield pointed to over-concentration on the use of steel in this field, at least in Britain.

Some spanwise models were mounted from fiber-reinforced in the 2 ft x 2 ft high speed tunnel at Hatfield.

One whole scale was used extensively in the investigation of shock wave interference.

Landing and takeoff characteristics were investigated in the 9 ft x 7 ft low speed tunnel using a larger complete model.

A flat plate under the model was used to simulate ground effects. The flat plate was slotted along the surface to direct the boundary layer underneath the plate.

Surfacing Result

One of the most satisfying results of this phase of the test program at Hatfield is regarded by the company as being the fact that when a larger complete model was assembled and tested in the 9 ft x 7 ft wind tunnel, the aircraft flew with the same area of the cross to be relieved forward.

With fixed leading instead of cambered tracks, de Havilland claims

Higher Jet Rates Asked by Insurer

London—At the end of the first year of liaison with jet aircraft operators, a London insurance firm has taken some steps to support its case for charging higher rates for jet aircraft.

Experimenting with jet aircraft had been reasonably in accordance with what could be predicted from piston and turboprop experience, according to Alan Bowes, chief insurance of British Aircraft Insurance Co. Ltd., a branch of London's Royal Insurance Co. The aircraft industry showed that four out of every 100 aircraft built were completely destroyed, in addition to experiencing partial losses, losses total.

Even so, we are now dealing with values which would give us losses on the big American jets on the order of \$25 million per 100 aircraft built," he said.

If these trends continue, there may be only 400 remaining, he added.

Insurer said there were currently about 600 jet and 800 turboprop aircraft on order—nearly half the number of piston-engine transports now in use.

We have a business which values are going up and up and the special risk of the large jets is going down," he said. Total loss values of world's aircraft fleet, which stood at \$1.6 billion, he added in 1965, and each airline has its own voluntary renewal date for its insurance he said, and new aircraft premium rates based only on gross tonnage from date of delivery to the next renewal, an otherwise never mind what they needed. He cited the earliest first year of jet losses where some 60 jets had been insured without insurance companies getting an annual premium on these aircraft.

Insurer suggested that a full 32 month premium be paid for each air craft from date of delivery.

Commenting specifically on the Boeing 707 and de Havilland Comet 4, Bowes said the fact that Boeing already has a 100 percent utilization program and required utilization figures of 100 for a date past will be effective within a year, and the aircraft itself. Although the Comet 4 had been involved in three major accidents and one had been totally destroyed in Bangkok, he noted "several encouraging factors" about the accident aircraft, but, but, the ground at a forward speed of 140 kt without damaging the engine of the fuselage and strength of the aircraft to gather with very efficient anti-torque devices had an array of fixes which "undoubtedly" would have been either



SELECTION from a family of eight light alloy full-wing models shows investigation of various thickened and unthickened wing sections during DH-121 research.

A guided missile intercepts
an attacking aircraft

at very low levels, up to great altitudes...

...AND BRISTOL SIDDELEY SUPPLY THE POWER

Bristol Siddeley Engines Limited produce the Thor missile. Two Thors power the missile in the Bristol/Ferranti Bloodhound guided weapon system. This system forms the most effective defence against air attack at very low, up to very high altitudes. And the great flexibility and development potential of the missile ensure that Bloodhound will be able to intercept any attacking aircraft for many years to come.

The missile is the simplest air-breathing engine that has ever been devised and the Thor is virtually a stainless steel tube which can be lifted by two men. A thrust of over 20,000 lb at Mach 3 can be expected from a typical canjet of the Thor's size.

At speeds of Mach 3 and upwards, the canjet has a lower specific fuel consumption and a lighter weight than any other prime mover, and the higher the speed the greater its efficiency. In fact, it is the most efficient powerplant for long-range flight at high supersonic speeds within the earth's atmosphere.

BRISTOL SIDDELEY ENGINES LIMITED
Bristol Aero-Industries Limited 280, International Aviation Building, Montreal 2, CANADA



The Bristol Siddeley Marine Proteus powers a naval gun mount used on board the Royal Canadian Naval Service patrol boats built by Vassier Ltd. Three Proteus deliver a total of 16,500 hp—gave these ships a speed of over 60 knots. The Marine Proteus is a two-shaft, two-stage, reheat and holds large reserves of power for acceleration.



The Bristol Siddeley Olympus high thrust turbojet powers the Avro Vulcan. It has a maximum dry thrust of 15,000 lb and captures a performance unmatched by any aircraft in its class. Current Olympus service distance 17,000 lb thrust dry—14,000 lb at 100% reheat. Bristol makes standard Olympus versions as rated at 33,800 lb with reheat.



Bristol Siddeley Maybach diesel engines designed for a wide variety of applications, including the British Railways 100 mph express train. The engine is a Bristol Siddeley diesel hydroturbine, motive powered by two Type XD 650 engines, developing a total of 2,580 hp. A large number of Maybach diesel engines have been ordered by British Railways since 1960.

AIRLINE OBSERVER

► Five Latin American airlines are expected to announce a merger next month that would create a major international air transport system capitalized at \$15 million. Initial meeting to discuss the plan was held in Panama last month. Second meeting, when technical aspects of the proposed merger will be discussed, will be held within a week in Lima, and a third and conclusive meeting will be held in mid-January. High costs of purchasing, operating and maintaining jet aircraft are given as the reasons behind the action. The five carriers involved are Avianca of Colombia, LAN of Chile, Compania Ecuatoriana de Aviacion, Compania Aerea de Ecuador and Ecuavias of Peru. Major companies would initially operate with the target transport.

► Presidents of nine International Air Transport Association member airlines operating between South America and Europe agreed at a special meeting in Paris to and their rate war in which IATA rates were being slashed by as much as 50% (AW Nov. 25, p. 47). Although it was expected the meeting would agree to a new common South American fare below the present level, the nine presidents agreed to maintain the present fare structure. Decision was reached at midnight of the final day of the two-day meeting.

► Pan American Airways will commence nonstop flights from Miami to and most additional routes probably will exist in South American Airways. The carrier plans to undercut the current longest routes by 30% beginning next October when it introduces Boeing 707 turboprop transports on its routes. The airline was one of the supporters of Transoceanic Airways Corp. at the International Air Transport Association traffic conference at Honolulu where the open route situation developed as a result of BOAC's flight for a 20% cut below current transit fees on the Eastern and African routes (AW Oct. 19, p. 38).

► Alitalia will launch an industry-wide program designed to expedite the exchange and disposal of excess spares and parts. Total value of such parts now on shelves is estimated at more than \$50 million.

► Lockheed Aircraft Corp. has received a purchase-for-delivery order from Trans American Aviation Corp. of Miami, Fla., for two Electra turboprop transports. The Trans-American Electra will be available for lease to and are easier to to large companies that might require traffic-journal executive transports.

► Aeroflot plans to continue the expansion of turboprop and turboprop service to new routes this winter. Tu-104B turboprops will be placed in service from Moscow and Leningrad to Saratov and the Crimea. Tu-134 turboprop transports will begin operating from Moscow to Yakutsk, Syktyvkar, Arkhangelsk and Monino and from Taldyken to Mineralnye Vody in the Caucasus. An-10 turboprops will be put on the Irkutsk-Tatik, Novosibirsk-Alma-Ata and Khabarovsk-Magadan routes in Siberia.

► Civil Aviation Board last week drew charges of "unconscious neglect" by the Aviation Services Committee of the Institute Builders Board of America which wants the agency to be more mindful of the airline industry's profit needs than its losses. The committee conceded that the new blood in the Board resulting from the recent appointment of two new members may spark new interest in the industry's earnings problem. The committee also urged that Airlines Air Transport Service activities be confined to essential minimum costs only.

► Trans-Canada Air Lines and British Overseas Airways Corp. have signed an agreement calling for integration of transborder schedules and interchangeability of tickets. Ticket and sales offices of both companies will conduct business on behalf of each other.

► New Zealand National Airways Corp. has signed four Fokker F.27 Friendship turboprop transports and takes an option on an additional seven. Leading competition in the New Zealand sales campaign had been the Hawker Page Dart Herald.

SHORTLINES

► Air Transport Association estimates that U.S. local service airlines will have carried 5,217,000 passengers by Dec. 31 as compared with 4.2 million passengers in 1958. The association also estimates that the 17 local carriers will post gross revenues of \$149,950,000 this year as opposed to \$94,654,000 for 1958. Other categories in the ATA estimates are: passenger miles, 1,057,497,000 for 1959 as compared with 820.2 million last year; available seat miles, 2,310,212,000 this year versus 1,793,5 billion in 1958. By mid-1959, local service carriers were serving 546 cities over a 47,000 mile route network.

► Alitalia, Italian state airline, will begin two Douglas DC-8 turboprop flights each week from Rome to Montreal beginning April 1, 1960, in competition with Canadian Pacific Airlines' two weekly Bristol Britannia turboprop flights which are scheduled to begin on May 1 over the same route.

► Allegheny Airlines will issue a single ticket to groups of two or more passengers traveling together to the same city on its routes under a new plan beginning this month.

► Federal Aviation Agency has voted for bids to be opened on Dec. 17 for the installation of six utility systems, four miles of runway and a jet parking apron 800 x 4,000 ft. at Dulles International Airport near Washington, D. C. Fog landing pads for helicopters also will be constructed.

► Irish Air Lines has resumed flights on its European routes following a strike by the cockpit crew and a strike in Ireland. Transatlantic flights were not affected by the walkout with senior living unopposed by a striking ship at Kilkish, Ireland, during the strike. Planes en route from New York were fully loaded with fuel at Kilkish, flown to Dublin, turned around and flown back to Kilkish without refueling at Dublin, refueled in Ireland again and flown on to New York.

► Pan American World Airways is scheduled to begin weekly Boeing 707-320 service from the West Coast to Sydney, Australia, via Honolulu and Fiji, on Dec. 15.

► Swissair plans to begin three flights per week from Stockholm to Lydia, Israel on July 1, flying Swiss Airline Convales turboprop transports in competition with Alitalia, which is scheduled to begin its Convales service on a three flights per week basis in Aug.



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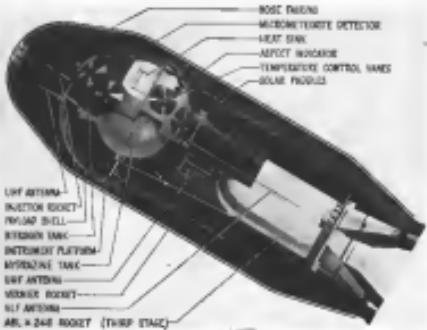
Experience in precision design and manufacture is the Bulova tradition—the Bulova capability—it has been for over 60 years. For more information write—Industrial & Defense Sales, 69-19 Woodlawn Avenue, Woodlawn, N.Y.

BULOVA



Payload: that was to have been sent into orbit around the moon is prepared at Cape Canaveral, Fla. Nozzle of tiny hydrogen rocket that was to help control insertion angle to ensure low orbital orbit. Rocket had capability of being turned

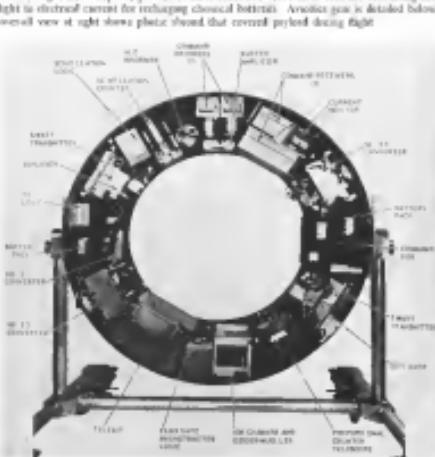
Attempt to Launch Lunar-Orbiting Payload Fails



Artist's conception shows layout of payload when covered by plastic shielding. Solar panel film is folded. UHFR antenna bracket the satellite angle reflector at top.



Attempt to send a complete 175-lb. payload into a low circular orbit about the sun was failed due to difficulties during the launching phase. About 150 lbs. of instruments were to have scanned the solar surface with a telescope like corona, measured propagation of ionized gas frequency electromagnetic waves in ionized gas in a magnetic field, measured the sun's rotation and the degrees of freedom of its polar axes, measured disturbance in speed of wavefronts emanated out of the flight, and measured density and types of substances in space. Baking problems did not allow for the Altair-Mars IV launching vehicle, but were solved for Altair 2040. The first flight of the Mars IV was planned to last four months. The photometer would have been used for determining considerable solar-weather propagation capability or spots of the solar heat source capability by U.S. boundaries. Mars come propagation research with capability of being four days long, and a space rocket, which could be fired twice, would have been first test of ability to measure initial mass. Altair-Mars IV was nearly 150 ft. long and weighed more than 250,000 lbs. at launch.



unusual capabilities and stability

64 channels In 60"

On these two pages eight fully transistored Model 850-1500P Preamplifiers appear actual size—each measures approximately 2" x 7" x 14". In each of eight, 64 preamplifiers take only 16" of panel space, and a blower unit another 4". Necessary power and stepped excitation is provided by a completely transistored Model 850-1500P Power Supply that mounts at the rear of each 8-preamplifier unit, so that no additional panel space is required.

INPUT CHARACTERISTICS

Input circuitry grounded, floating, isolated from earth ground, ground return, input impedance 100,000 ohms (plus), plus 100 ohms intermediate at 1000 ohms with 1000 ohms for gain of 10, 20, 30, 50 and 100 and smooth gain control to reach any intermediate setting.)

RANGE/INPUT

DG to 70 dBs 1-3 dBs.

RANGE TIME

25 ms to 25.9% of steady state value.

OUTPUT CHARACTERISTICS

Floating independent of input gain line assembled.

Characteristics: $0.1 \text{ v. versus } 300 \text{ ohms DG}$ to 70 dBs and $1.5 \text{ v. versus } 300 \text{ ohms DG}$ to 25 ms .

Output 1 (maximum 1000 ohms) output in series 300-ohm internal load, isolated by bypassed 4-mfd capacitors. Part B (at 1000 ohms) 300-ohm load and 1000 ohms can be supplied externally. In any combination of 10 and 200 ohms.

LINEARITY

$\pm 0.1\%$ of full scale output (2 v. yellow).

SWING

100 dBs overdriven for 3 v. yellow. Preamplifier with gain of 2000/3 v. line limit for 3 v. yellow when available on panel under Gain switch— ± 2.5 dBs line limit.

IMAGE REJECTION RATIO

220 dB at 1000, 180 dB at DC, with 1000 ohms gain reference to source.

LINEARITY

± 2 v. peak to peak referenced to input. Measured over DC to 1000 dBs. Noise also checks for full scale input noise to measure 0.2% of signal processing noise and equal to 1000 dBs.

DRIFT

± 2 v. referenced to ground at constant ambient temperature after 30 minutes warm up. Input 600 ohms temperature equivalent to $2 \text{ mV}/^{\circ}\text{C}$, max.

OVERLOAD RECOVERY

Preamplifier recovers from full overload conditions within 20 milliseconds after removal of signal. 10-volts of signal attained with no damage to preamplifier.

POWER REQUIREMENTS

Each Preamplifier requires 2.3 Watts. Model 850-1500P Power Supply handles up to 16 Preamplifiers.

\$462.50

per channel, complete

Each Model 850-1500P Preamplifier costs \$462.50, each Power Supply for every eight Preamplifiers, \$200. Consider the substantial savings in panel space, the low cost of the required equipment—where economy is often not a multiplying like factor elsewhere you're saving 300 dollars with G. E. Westinghouse, Mass., within an enclosed 12 x 24 ft.

What distinguishes this data preamplifier from others is not its specifications alone—but the combination of the performance with high reliability, practical cost and small size. Together, they make the difference.

Model 850-1500P is the logical choice for data processing systems in which tens or hundreds of channels of information must be handled.

Completely transistorized, the Model 850-1500P is designed for amplifying low level inputs such as thermocouple, strain gage and resistance bridge outputs. Typical outputs include digital voltmeters, logic monitors, scopes and other modern devices.

Complete engineering data and application assistance is available from Sanborn Company. Contact your nearest Sanborn Industrial Sales-Engineering Representative, or write the main office in Waltham, Mass.

New Data Preamplifier model 850-1500P



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Minuteman Tests Yield Silo Design Data

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Actuator operates a simple but effective web strap
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Edwards AFB, Calif.—Series of underground silo test firings of the full-scale model solid-propellant Minuteman ICBM now have pushed back to 1970 the required environmental loading phenomena which promises to last the remainder of advanced follow-on testing at Patrick AFB, Fla., and Vandenberg AFB, Calif.

Underground sites at Edwards are galvanic test railfounds—two holes about 35 ft. deep and 26 ft. in diameter over all (SW, Aug. 3, p. 93). First group of firings in the series of tests at Edwards is being conducted with a "bunchy" configuration, composed of dummy second and third stages coupled to a live first stage which is partially fitted to give a thermal burning base. Second group of firings in the series at Edwards will use lightweight flight casings more closely approximating the test configurations of the missile to give results that will closely approach operational conditions.

The full array of Edwards' tests should provide enough environmental data for isolator and engineering analysis to design full-scale controls and development installations for advanced Minuteman testing with a configuration

very close in all respects to the production operational weapon. At Edwards, Patrick will be chosen as the site for three firings because of all the advantages the base itself offers as a test area as well as the wide expanse of the Atlantic Ocean to the east of the site.

Indications are that Patrick is preparing for those tests into two months or being just. There now describing the type of hole that Minuteman will require.

Firing Control

A launch control center for these Minuteman silo batches would not be required since Patrick already has enough blockhouses for its continuing ballistic missile test program. Minuteman control could easily be tied into these existing facilities.

Concerning the present state of the Minuteman development program and the number of 300 problems that must still be solved before advanced research and development testing is finished, the program, tests at the Patrick complex could be at least a year away.

After the research and development

testing at Patrick, an operational development phase for Minuteman probably will follow. Since Minuteman will be a Strategic Air Command weapon, this operational development phase, thought experts, would be conducted at Vandenberg AFB. The site of SAC's ballistic missile training and operational development program.

If the operational development phase is conducted at Vandenberg, chances are that it will not be with a complete system with components that have not been evaluated previously. This means that support equipment for the missile would have been proved out elsewhere and the complete system assembled for checkout at Vandenberg as a logical operational proving site.

Meanwhile, at the Edwards site, launch development program for Minuteman components are being used to verify that the functions of stages will work. One silo should be chosen to be the site for a test, and the other will be out of commission, another will be available as a backup facility.

The first three shots in the initial series at Edwards AFB already have been fired successfully. Present schedules anticipate that the series of tests



Polaris System Tested on Nuclear Submarine

Medium-size blue waves of water explode from one of 36 Polaris missile tubes on nuclear submarine George Washington during firing system tests at Groton, Conn. Slope wave was a one-ton cylinder, visible at top of shot at right. Unit was activated for later test.



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The product of Pesco's five years of experience in the
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at Edwards will run until April or
May, 1960.

One of the major problems facing
Air Research and Development Command's Ballistic Missile Division, which
has cognizance of the Minuteman pro-
gram, was determining the best
configuration for the silo location. Economy
of the site design is a critical factor in
the deployment of the Minuteman
missile system because of the large
number of sites which probably will be
used to ensure a reasonable factor of
survivability for retaliation after any
surprise attack. No specifics on the
number of site installations planned for
the Minuteman system have been re-
vealed, but the general estimate was
under consideration for Minuteman's
missile strength ranges from the
middle hundreds to the high thousands.

Silo Types

Three general types of silo schemes
for Minuteman have been under consideration:

• **U-Type.** In this scheme, the missile
would be deployed in one of the arms
of the U, with the exhaust directed
around the head of the U and up
through the other arm to the surface.

• **Concentric holes.** This proposal uses
a central hole with an annular exhaust
space surrounding it to lead the gases
to the surface. In effect, it is similar
to the U-type except that the exhaust
gas passage is annular instead of diam-
eter up through the access U-hole arm.

• **Single silo.** This is a single blind
hole, with exhaust gases evacuated
from the hole directly at the side of the
missile. This scheme would use a baffle
deflector—a configuration similar to the
outer ground-based anti-ballistic missile
engines shown above. This deflector
also could be used with the concentric
hole silo configuration.

Except for the U-type type of silo
no precise data was available on site
environmental phenomena.

Single Silo

The single silo has the most difficult
configuration technically but will
offer the greatest promise of economy
and uncomplicated operation. It was
decided to tackle this silo scheme first
and, if it did not prove feasible, resort
to the U-type or concentric hole-up
proposal as alternate.

Plans for tests at the Edwards site
have been developed to conduct the
functions of the single silo scheme, to
try to provide a baseline effect with
either a U-type or concentric hole silo.

In the fallhole model first from
the Edwards site, the missile is retained
at the base by a cable or cable which
takes the form of a coil to restrain the
missile so that it will not rise more
than a few hundred feet above ground.



U. S. Air Force Academy instructor "Mach 1" inspects nose cone down—part of Texas Instruments infrared optics that had fallen inside to impact.

INFRARED SPECS FOR THE FALCON

Falcon Missiles—as deadly as its feathered namesake— is gefied to the kill by Texas Instruments Infrared optics. Unlike nature's Falcon, this Air Force missile has only the combative instinct, attack accuracy, and destructive impact that are built into it at the design and manufacturing levels.

Imparting these methods to inanimate systems is the business of TI optics engineers and craftsmen. Leading designers and producers of silicon, germanium, quartz, and other optics for infrared applications, TI optics teams have finger tip familiarity with unusual materials suited to specific portions of the spectrum. In one of the nation's best equipped facilities, TI optics specialists grind, polish and coat components with accuracy that extracts the most from even the weakest infrared signal. This experience can work for you. Whatever your needs... prisms, lenses, windows... TI's full-time engineering services, modern computers, and complete optics facility can meet your requirements from design to delivery. For detailed information on any phase of precision optics technology, contact **SERVICE ENGINEERING**.

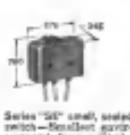
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Series "MP" miniature pushbutton switch—Latched pushbutton seven-pole, part-silver, precision wear resistance. Die-cast aluminum button offers additional reflection. Each operation transfers current of the maximum contacts.



Series "5E" small, sealed momentary-free switch. Potted leads. Lead and roller-leaf auxiliary switches available.



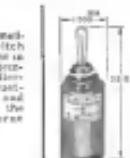
Series "HS" hermetically sealed switch—Hermetically sealed with Pne. 5-2-L, MIL-S-5775A. Features constant operating characteristics in all atmospheric conditions.



Series "VH" high temperature basic switch—Hermetically sealed withstands radiation, 400°F temperatures. 30 vdc rating and 10 a. res. 10 a. water 6 a.



Series "HR" hermetically sealed switch—Hermetically sealed from -65°F to 600°F temperatures. Roller plunger is adjustable. Design and construction for the roughest airborne use.



Series "ET" electrically released toggle switch—Works as a supplementary action switch, but is designed to supplement a normally closed switch. Individual or energized. Provides remote electrical release. Enclosed in a rugged, hermetically sealed enclosure. Available in 1 or 2-pole designs.



Series "TR" radio-oriented key switch—Provides positive and edge-light indications. Biased switch design with stepped tact switch. Available with 1, 2 or 4-pole circuitry.

Each of the switches illustrated on these pages represents a different series of micro switch precision switches. Each switch has been designed to high reliability standards for a particular purpose. Each series includes many variations—size, weight, contact arrangements, electrical characteristics, housing, actuators, sealing, temperature, shock and mechanical characteristics. For example, there are 100 different switches in the "EN" Series. No other source of precision switches offers as broad a line. Furthermore, no other can offer the services of as large a staff of Application Engineers in branch offices at strategic points throughout the country. Consult the yellow pages.

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Series "CE" G.S.E. limit switch—Welded-plate construction—momentary and latching switch. Biased plunger actuator.



Series "IRB" high reliability selector switch—For mobile programs—covering 24 gold-plated contacts and rotary selected in hermetically sealed contacts.



Series "IRW" shock-resistant selector switch—Meets requirements of U.S. Bureau of Ordnance for shipboard launching equipment. Encapsulation-proof construction.



Series "IRY" high-current selector switch—Heavy actuator adjustable through 360°. External band switch. Rating 10 a, 115/230 vdc, 30 wts. Environmentally protected. Positive, sealed contacts.



Series "IP" roller lever switch—Rugged, sealed two-pole sub-compact enclosure. Two high-capacity split contacts. Sealed contacts are captive.



Series "IPR" roller limit switch—Heavy duty two-pole switch. Positive and direct and limit functions. 10 a. 115/230 vdc. 30 wts. Contact can be replaced in seconds. Available in a variety of actuator designs.



Series "ISSE" sub-modular switch—Smallest precision, snap-action switch. Bi-polar features two parallel contacts. Hermetically sealed, rugged, easy-to-set terminals, 5-amp capacity at 115/230 vdc.



Series "ISAS" safety selector switch—Corrosion-resistant housing; eight separate circuits with infinite switching sequence. Available with three switch units.



Series "ISAS" safety selector switch—Corrosion-resistant housing; eight separate circuits with infinite switching sequence. Reliable operation, wear-free contacts. Intrinsically safe switching sequence. Available potted in steel housing.



Series "IPR" roller limit switch—Most sensitive. Bi-polar switch. Operates reliability over 100,000 cycles. Bi-polar switch. Also available with roller plunger and side mount, pin plunger.



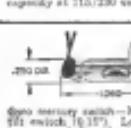
Series "TL" pull-to-break toggle switch—Rating at 25 vdc res. 20 a., 100 vdc res. 25 a. 125 vdc res. 10 a. A variety of toggle lever positions. Provided as 1, 2, and 4-pole designs.



Series "TL" pull-to-break toggle switch—Bi-polar, sealed two-pole switch. A variety of toggle lever positions. A variety of locking arrangements. Also in 1 or 2-pole designs.



Series "TR" radio-oriented key switch—Positive and edge-light indications. Biased switch design with stepped tact switch. Available with 1, 2 or 4-pole circuitry.



Series "TR" radio-oriented key switch—Positive and edge-light indications. Biased switch design with stepped tact switch. Available with 1, 2 or 4-pole circuitry.



Martin B-57 Carries Bomarc B Nose Section

Martin B-57 has been modified in forward section to carry the nose and part of the guidance section of a Bomarc B air defense missile for tests of Eglin AFB. This hybrid plane- missile will check out capacity of Eight Gold Test Range to handle flight tests of the 100-mile range Bomarc B, particularly the capability of the range television system and underground transmission line for missile padding.

data on pressures, temperatures, atomic environmental factors, vibration and static durability.

Stainless materials are not a consideration in this study to date.

However, results obtained in the test program will indicate materials that might be used for solo design criteria—both for the basic test program and

the ultimate operational configuration.

For the series of flights in the Edwards site, Boeing Airplane Co. is the assembly and test contractor, a conducting the tests under the Ballistic Missile Division's field office manager.

Air Force and Boeing technical personnel did not go directly to the full-

scale model Minuteman tests. A number of preliminary investigations were conducted.

• In first trials, the Air Force Flight Test Center personnel at Edwards orbited a missile configuration, a single take-in April, 1958, to determine that the simple solo configuration would not be disastrous in a firing (AW Jan. 14, p. 58). A house-size missile test device was constructed which simulated realistic mass-to-weight ratio for Minuteman, but no simulation of flight temperatures or chamber pressures was attempted. A number of successful test flights have been conducted with that rig.

• Next step, begun in December, 1958, was to establish a 1/20th scale cold flow—a simple arrangement of a solo and missile, with compressed gas introduced through a slot at the fore end of the missile. With that single solo static test, eventually a wind-tunnel arrangement, about 2,200 runs were made, varying the test parameters with solo configuration, solo diameter and east angle. Data obtained included aerodynamic force and moment on the missile, which helped to determine solo stability. Also obtained was data on fuselage deflection phenomena.

• Hot flow experiments were conducted at Edwards AFB in September 1958 by Air Force flight Test Center personnel. Approximately 100 runs were made, using a modified 2774-ti aircraft as a test platform and a flight missile. The tests provided quality flow information on pressurizing flows, deflected shapes, as well as data on localized heating on the Minuteman airframe.

• More advanced experiments, experiments were conducted in a 1/20th-

scale hot flow rig. These were conducted at Boeing's plant and utilized a small rocket engine in a static arrangement. Approximately 150 runs were made with this rig, producing additional information on aerodynamic forces and moments.

Heat Data

Also obtained were heat transfer rate data, first achievable with a cold flow rig, and accurate data.

• Next experiment, this using a simple solo configuration, employed a one-third scale static rig at Edwards AFB with tests conducted by Air Force flight Test Center personnel. First firing with this arrangement was in February, 1959. The solo was mounted horizontally for convenience of operation. In sequence, continued through April, 1959, and after four tests had been run, Boeing Minuteman assembly and test personnel took over the previous experiments which had been run by Air Force flight Test Center staffers. To date, approximately 15 runs have been made with the one-third scale model static test rig.

Experimental Opportunities

These flights provided the first experimental opportunity to

• Conduct experiments on a solo solo-friendly base to validate the nature of the solo- static problems.

• Confirm results of the 1/20th scale trials as well as from different platforms.

• Accumulate accurate data mass ratios representative of Minuteman solo environment.

All these preliminary scale experiments established parameters of solo and ground rules for the full-scale solo tests at Edwards which followed.



Soviet Pilot in Altitude Chamber

Soviet high altitude test chamber to study physiological reactions of pilots for possible space flight operation at Moscow. Above: Zone Atmosfera under laboratory tests, also its control instruments, note chart to record pressure. Below: Gennady Mikhalev, a test pilot, is shown in the chamber wearing pressurized equipment, which enables him like for low pressure.



Radioplane RP-76 Rocket-Powered Target

Radioplane RP-76 solid rocket-powered target missile will be used as U. S. Army Nike Ajax and Hercules high altitude training missile RP-76, being built by Radioplane under a \$2.5-million contract, is subcontracted and is manufactured by purchase. Airframe is mostly honeycombed glass fiber plastic. Target has reached Mach .94.



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FINANCIAL

Avionic Makers Fight to Maintain Growth

New York—Rapid growth by many avionic companies has brought with it related problems, such as demands on management to keep the rise strong or the competitive drive to take profits off equipment contracts in the hope of gaining new production business.

A typical case in point is Electrosonics, Inc., Electronics of Boston. This company almost went bankrupt because of three development programs on which more development was required than originally estimated. A mobile home radio system and SPAR, a process approach radar system, which cost the company \$14 million, and Datura, a large size computer system.

In 1959, the company lost \$544,000 and new management was brought in. In its 1959 fiscal year ended Aug. 30, the company won more than doubled its 1958 volume, reaching a total of \$23,410 and it earned \$575,000 after taxes. It was able to cut its accumulated debt from \$715,000 in 1959 to \$140,000.

Most of the rapid rise in volume is due to the company's APN-105 and APN-130 doppler navigation systems for the Republic F-105 Thunderchief fighter-bomber. Of the company's 1959 volume, a contract for 130 of these systems accounted for \$11,900,000 and of the company's fiscal year end backlog of \$36,300,000, two doppler production contracts accounted for \$29,300,000.

New Business Search

Thus, finding new business is as important to the company as an instant success over time problems. It recognizes the danger of being tied heavily to one single military program, though the market for the F-105 or the instrument loads from through 1962, based on orders in 525 aircraft. This does not include another 400 which might be ordered for Tactical Air Command or foreign orders.

Electrosonics Electronics is working in several directions for broadening its operations.

- Foreign business. The company has negotiated with Pekker and also with engineers in France and Italy for overseas business. This would include not only doppler systems for an foreign or domestic F-105s and possibly avionic gear for the Grumman F-14A, but also commercial business in the European Common Market.
- Mergers. Though a recent proposal that it merge with Semiconductors, Inc., was turned down by the company's



LABORATORY FOR ELECTRONICS Doppler navigation system in the Republic F-105 is run through ground test in the aircraft

board, a merger preferable with a West Coast company with electromagnetic capabilities is still being actively sought. The Semiconductors step fell through when its earnings failed to reach estimates in the negotiations.

- New products. The company has 500 of its 2,000 engineers engaged in research and development. It is still interested in the computer field. Its Computer Products Division volume was \$1.5 million in fiscal 1959 and is expected to grow to \$2.5 million in fiscal 1960. Based on five year forecasts of total volume of \$700 million, this division may contribute 25% of sales and more than 50% of profits.

Maintaining Growth

Henry W. Hartung, who was brought in as president in 1956, and who has made the sales growth rate a key importance to the company's future, from a flattening of the curve can have adverse effect, he pointed out. Among

other things, a steadily rising curve is important in attracting and holding the technical people the company must have to compete.

He estimates sales for this fiscal year will reach \$35 million and earnings somewhere between \$800,000 and \$1 million.

An important financial backer in the company's life is David Radcliffe and the company is his only venture as a large individual investor, and not in competition with the banks. A substantial holder of the company's common stock, he found himself locked in when the delinquent appeared and to safeguard his investment found it necessary to put another \$500,000 into the company's 65% convertible preferred stock.

to keep the company operating in 1978. Besides cutting out several unprofitable lines of instruments, including its telescopes, the new management has consolidated the company into one plant in Boston instead of the five it previously used. The plant is leased at a cost of \$899,600 annually. The lease characterized what otherwise would be "leasehold" control costs.

Operations have been strongly oriented toward obtaining prime contracts. Not only does this set at a safe guard against the annual bonuses in terms of contracting volume, but the plan to pull back work into the house, let it be other adventures.

In the company's two double-occupancy meetings mentioned earlier, there is also at least 57 inches of space between that will be added. These fringe benefits can help volume significantly. Building points out:

The company has had some difficult and reliability problems and a reliability group was set up as a result. It found that 50% of its reliability problems on the supplier's system were simple difficulties at selected points, possibly a production line problem, not design.

New Offerings

Telephone Manufacturing Co., Amherst, N. Y., engaged in the manufacture and sale of telemeasuring equipment for guided missiles and industrial telemeasuring systems and other external telemeasuring equipment. Officers: President, W. G. Clegg; Vice President, C. H. Clegg; Secretary, W. G. Clegg; Treasurer, C. H. Clegg.

Manufacturing Co., Inc., for advances to Universal Traction Products Corp., in connection of manufacturing facilities and the purchase of equipment and other corporate expenses.

Copperrod Steel Co., Pittsburgh, Pa., engaged in the manufacture of chrome cable for automotive industries and tubing and tube assemblies for automotive support equipment. Offering is \$5,000,000 of convertible debentures, due 1978, for public sale. Proceeds will be used to pay short-term notes, balances will be applied to the company's general funds and used, together with other funds, for the expansion and improvement of the company's manufacturing facilities.

Transistor Electronics Corp., Wakefield, Mass., principal business the development, manufacture and sale of semiconductor products. Offering is a common, with 1,300,000 shares of not exceeding common stock, involved, plus and terms to be supplied by amendment. Selling stockholders are David Balash, president, and Leo Balash, board chairman and treasurer, who own an aggregate of 98.65% of the company's outstanding stock, each in addition 500,000 shares.

Mohawk Airlines, Utica, N. Y. Offering 53,500,000 of 6% convertible debentures, due 1976, \$1,917,500 to be offered in exchange for 1/4 the amount of the company's outstanding 5 1/2% convertible debentures, due 1966, the remainder, plus any not taken in the exchange offer, to be offered for public sale. Proceeds will be used to meet

tion programs, and for increased research and development activities.

Boswell Instrument Corp., Fort Wayne, Ind., principal business is the design and manufacture of electrical/mechanical apparatus for scientific instruments. Offering is 75,000 shares of common stock, no par value, to be offered for public sale, 45,000 shares of which are being offered by the company and 33,000 shares by stockholders. Proceeds will be applied to the company's general funds; a portion of the proceeds will be used to retire short-term loans, in the amount of \$200,000, caused by various capital expenses.

Andex Corp., Zionsville, Mass., proposed business plan of design, development and manufacture of high speed printers for use in association with computer and electronic data processing equipment in industry. Offered at \$1,259,800 of subordinated debentures due 1974, with warrants attached to purchase 45,000 shares of common stock, \$1 per value, \$2,960,000 of subordinated debentures and stock to be offered in an amount of \$50 principal amount debentures with attached warrants to purchase one share of common stock and two shares of common stock. Proceeds to be used to pay off all debt and available cash, to finance the company's continuing serial notes, to reduce any accumulated dividends on the 2,280 outstanding shares of cumulative preferred stock to pay a premium to the Anderson Nichols & Co., to be used for inventory and equipment, and to balance for general corporate purposes.

Acquisitions And Mergers

Heli-Coil Corp., Danbury, Conn., after selling 117,500 shares of its common stock without par value to the holders of outstanding shares of the capital stock, \$10 par value, of Gug Net Corp. The holders of 95.5% of the outstanding Gug Net capital stock have converted into an agreement with Heli-Coil to exchange their holdings of 105,000 shares of Gug Net stock for 105,000 shares of Heli-Coil's common stock. The agreement contains a provision

United Control Corp., Seattle, Wash., principal business the design, manufacture, and sale of control systems, electronic equipment and accessories designed for military and industrial aircraft, missiles, space vehicles, and industrial uses. Offering 32,500,000 principal shares at \$100 per share, due Dec. 1, 1974. To be offered for public sale, proceeds will be added to the company's general funds and will be used for working capital, expansion of plant facilities, and to finance plant, except for 10,000 shares at \$175,500. The New York Stock Exchange has no present intention of listing any of the shares of Heli-Cell that have been pursuant to the proposed exchange. Following the exchange of 100,000 shares, the remaining 31,500,000 shares of the shares of Heli-Cell may be sold back to the trustee in case of the exchange. Not short of 100,000 shares held at present, cannot at the time of sale, Heli-Cell will receive no proceeds of the unexchanged 100,000 shares.



From the Atlantic to the Pacific whenever a missile leaves the launching pad odds are better than 5 to 1 that faulty reentry is being coordinated by timing signal systems made by Elsintec Engineering Company of Camarillo. In the 10 short years since it first launched a homing

Several important career opportunities are now available in EEC's marketing department. For



Electronic Engineering Company of California

Alloyd Explores Gyro Cleaning Technique

By James A. Fause

Cambridge, Mass.—Substantial increases in the life of bearings for the highly precise gyroscopes in inertial guidance systems have resulted from a research program now under way at the Alloyd Corp. in collaboration with Massachusetts Institute of Technology's Instrumentation Laboratory. Alloyd, a company founded in 1957 from the MIT facility, has been studying the problem of precision bearing operation since 1958 and presently holds contracts totaling about \$400,000 from the Navy and Air Force.

Ahesive Particles

The company believes that it has demonstrated conclusively that a prime cause for the friction problems can be considered with gyroscopes is contamination by adhesive particles of the gyro's precision bearings and that it should be possible through proper cleaning techniques to markedly increase the life expectancy of these bearings. Although Alloyd, it should become possible to make these bearings last longer than the gyroscopes and perhaps with still less lubricant for longer periods of time than at present. This would improve

gyro performance without adding the complications or a change to electrostatic or gas-supported bearing systems.

The method most commonly used at present to examine bearing components for dirt and foreign matter is visual inspection. In terms of a stereomicroscope at magnification of 20 to 40 diameters with a standard white light source, the results are poor. Alloyd has conducted a series of field bearings supplied by MIT's Instrumentation Laboratory. In attempting to improve the resolution of the inspection procedure used on bearing surfaces, various microscopic techniques were tried, such as dark field, interference microscopy, and the use of polarized light.

Polarized light microscopy proved to be the technique which provided the most useful information. Using polarized light, it was found that particles on the surface of the bearing which were transparent and therefore invisible under other light sources, showed up distinctly. The light scattering properties of these particles, which may have a variety of configurations and sizes, may also be measured or transduced. Later work indicated that these particles were either embedded in the raceme and balls or

held on by electrostatic attraction.

Comparison of these particles with materials used in finishing operations during manufacture of the bearing indicated that they must be grinding or lapping compounds. Samples of the compounds normally used in finishing of these precision bearings were examined. The same shapes and sizes of these particles were found to compare with those of the particles found in the bearings. To determine that this material was actually left in the bearing in manufacture other than scrubbing, tiny bearings made by different manufacturers and of a variety of sizes were obtained and examined. Particles were found in all of the bearings inspected.

The technique of using polarized light has proved to indicate that with practice it is possible to tell whether the finishing compounds are empty, abrasives or diamonds. Alloyd considers that in view of the size and quantity of the particles found, it would be reasonable to suppose that they have not been scrubbed off. The company points out, however, that these particles are elusive and under polarized light, under white light conditions they are completely invisible.

Types of Failures

Gyro bearing failure is evidenced in several forms, such as:

- Friction behavior caused by dirt contamination.
- Failure through distortion of rotation.
- Slow but marked increase in friction level with time. Related to sufficiently contaminated bearings is the fact that as the extent of the gyro error cannot be kept at a safe operation speed.

Failure of materials within the bearing is obviously serious, as is failure resulting from "rocky" contamination within the bearing. These defects, however, can be detected through the use of a slow-speed diametral type which measures vibrations transmitted from a slowly spinning bearing and from the traces on a chart it is possible to pick out defects in geometry, and lubrication and dirt contamination.

It is the friction increase type of bearing failure which is the most costly and which presents the greatest problems because it may take place over a long period of time. This form of failure as evidenced by a delayed increase in running torque is termed a lubrication failure, and bearings which

were examined after such a failure invariably showed a heavy layer of varnish deposited within the narrow.

With the discovery that ground surfaces can be contaminated with abrasive materials, Alloyd theorized that the cause of bearing failure is the polarization of the lubricant. It has been known for some time that a clean, or oxide-free, metal surface can act as an excellent catalyst for the polymerization of oils and the action of abrasive particles in the lubricant is to make yet such clean surfaces. The immediate solution to this problem would then be to remove the abrasive contamination.

Cleaning Tests

Alloyd, working in cooperation with members of MIT's Instrumentation Laboratory, has conducted a series of tests covering all kinds of cleaning operations. A large number of ultracells were tried either alone or in an ultrasonic cleaner, but none was entirely successful. One reason was that while most of the particles were actually embedded in the steel, others were held to the surface by electrostatic attraction. Wiping merely moved them from one place to another on the bearing.

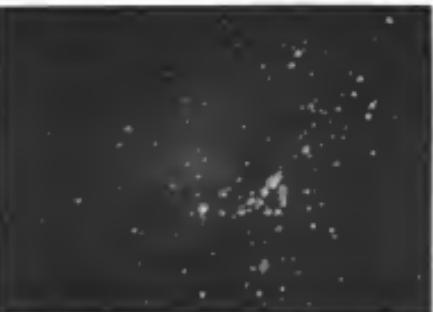
The only effective cleaning technique suggested to date has been the application of a wash bath by means of a 1% metal solution. Recognizing that there might be some detrimental effect to the surface of the bearing from this kind of bath, a series of tests at a low temperature was conducted at MIT. The bearings cleaned with this method. These tests are aimed at determining if the long life expected from "clean" bearings can in fact be observed in actual use. Preliminary results indicate bearing life will probably be substantially extended.

Contamination Sources

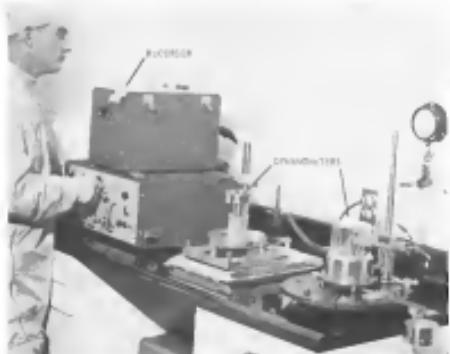
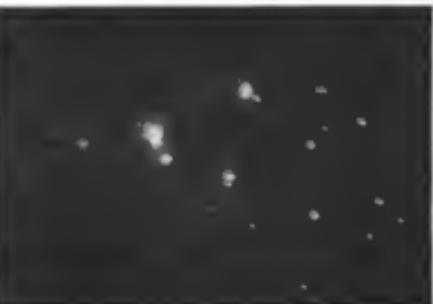
A corollary to this work is the discovery that other sources can contribute abrasive contamination material besides the compounds used in the lapping and finishing processes. For example, it was discovered that steel wire or a plunger of a hydrometer needle, usually generally is lapped in place with a grinding compound using a diamond needle to oil a bearing, leads directly to contamination by abrasive material.

Another source of contamination is the lubricant itself. It is common practice to process the lubricant used in these gyro through various filters. Alloyd measured the fact that a relatively large supply of lubricant which had been filtered in this manner was thoroughly contaminated with abrasive material coming from the filters themselves.

AT 200 X magnification, portion of ball bearing shows damage from finishing operation.



WITH some fine oil in top photo, polarized light shows contaminant particles in sharp focus (bottom). Photo below shows particles as they appear after being cleaned under polarized light.



BEARING is examined in the Alloyd investigation by means of the experimental setup shown above. Slow speed dynamometers spin the bearing (right) and the torque output is amplified and displayed on the strip-chart recorder at the left.

Puerto Rico Radar Construction Set

Itaca, N. Y.—Inertial effects of ballistic missile travel through the upper atmosphere and radio astrometry studies will be conducted by Cornell University with a 1,300 ft diameter solar facility in Puerto Rico.

The \$4.5-million solar facility, to be financed by the Advanced Research Projects Agency (AW Nov. 16, p. 115), is expected to be fully operational with in two years from the time construction begins in February, 1968. Test borings are now in progress by the Army Corps of Engineers at the site, a coastal bowl of coral limestone.

The fixed radio antenna will be a 1,000 ft diameter parabolic dish with a 600 ft high tapered supporting the feed antenna. The stationary antenna will be able to swing its beam only 20 deg from the vertical, offering a beam sweep of 40 deg. Despite the limited beam sweep, the location of the installation at Puerto Rico provides an equatorial latitude (18 deg. N) for access to the solar system and to the Adantic Missile Range.

Peak range of the solar will be 2.5 uw, and the transmitting frequency will be from 410 to 460 mc. The low frequency, long-wave length signal will not preclude the resolution of the U. S. Navy Radio Research Station at Sugar Creek, W. Va., which will be capable of operating at much higher frequencies. Nor will the fixed radio facility be of value for space vehicle tracking.

Cornell has established a Radio-Physics and Space Research Center which will operate the large solar station for ARPA contract. Directing the center will be Prof. Thomas Gold, a British cosmologist known for his work with Hermann Bondi on the theory of cosmology.

The solar will measure electron density and electron temperature at different heights and times in the atmosphere.



Soviet Radio Telescope in Armenia

Photograph shows part of what appears to be a large linear array which at one portion of the largest radio telescope known to exist in the Soviet Union. Telescope is located near Erevan, in Soviet Armenia. Feed radio telescopes such as this utilize the earth's ionosphere to use a system of delay along the equatorial plane, and can employ interference techniques to separate oscillations.

Sphere Additionally, it may measure ionization and detect ionizing streams of atomic-charged particles from outer space in connection with the phenomena and explain the existence of ring current.

The installation is believed capable of showing solar radio echoes from the moon, Venus, Mars, Mercury, the sun and possibly Jupiter. Gold asserted that there may be a relatively high density of atmospheric before solidify occurs on the surface of Jupiter. If no signal is obtained, however, will know that Jupiter is shrouded in a deep atmosphere that dissipates radio wave's strength.

1968
FILTER CENTER
1968

Ultra-High-Speed Computer-Digital computers that operate at computing speeds of 1,000 use must be advanced in the next decade using microcircuit planarized oscillators as the logic computing element, according to C. S.

Burroughs Wins ALRI

Burroughs Corp. was Air Force was given the Air Force Long-Range Radar (ALRI) contract (AW Nov. 7, p. 21), which, in the first stage, will receive \$7 million and will run 43 months.

ALRI is a radar station located in a Lockheed RC-121 communications aircraft which will provide improved extension of the SAGE system. Burroughs has previously been awarded approximately \$324 million in SAGE contracts.

About 90.65% of Burroughs' work on the ALRI project will be subcontracted, including Rightshifting of aerospace parts and most parts of communications and navigation equipment.



He put a new twist in an old trick

His problem was to take a 2" x 6" x 3-foot piece of waveguide tubing made of .06-inch thick aluminum and to twist one end 90° to the other without breaking or stretching any part of it...that is a cross section taken anywhere along its length remained a perfect rectangle.

The standard solution for a problem like this: Support the tube internally with a solder-like substance that's melted on, coated, melted out after bending, it won't work here because the mass of the substance is too great.

Here's how this AMF production engineer faced the answer. First he visualized the concept that, on any symmetrical twist, the center axis never moves. Then he applied this concept by stretching a metal rod through the center of 250 rectangular bars, inserted them in the tube, encased them with the same solder-like substance. Jaws clamp on either end. One of these translates angular rotation over 2.5 degrees, giving the metal tube to bow. The result: Perfect bends, every time.

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Plastic Radar Reflector for Tortor

Plastic radar reflector being assembled at Republic Aviation Corp. plant in Farmingdale, N.Y., will be first in world Tortor missile system on U.S. Navy ships. Reflector is 8 ft in diameter, weighs 324 lbs, and can withstand shock load of 100,000 Gs.

Herring Radio Corporation of America (BCA) is investigating, under Navy Bureau of Ships sponsorship, the technique in which the digital "1" or "0" is represented by the plane of the nail-like signal.

So far, BCA has performed single computer functions at a linear rate, and is preparing to complete functions at a rate of 250 "1's" a second. According to Herring, RCA uses printed circuit wave guide and a special wave-guide cavity function divide for its waveform. Although operation at microwave frequencies poses new computer design problems, it has certain advantages in addition to speed. For example signals can be combined in positive striplines to perform certain logic operations, such as inversion of phase. Up to 180 deg delay of the carrier. Hybrid ring and klystron isolators can be used to give information discontinuities which is not possible at base rate terminal negative resistance amplifiers, Herring says.

► **Navigations** AM Spreader—Computer-processor system designed to detect presence of enemy low-flying aircraft within radar sectors radiating from a particular aircraft and to transmit information to destroyers. System is being developed for Army Signal Corps by Electronic Units & Photographic Corporation's Government Electronics Division.

► **High Temperature Thermometers**—Platinum resistance thermometers, for

interpolating between fixed points on the International Temperature Scale between 610 and 1,050°C has been developed by National Bureau of Standards. New instrument is accurate to within a few tenths of a degree in this upper temperature range. NBS reports

► **Maritime Data Systems**—Maritime and solid-state airborne data acquisition system, developed by Gulton Industries, weighs 7 lbs, occupies 730 cu in, consumes 15 watts power, can monitor up to 30 reading voltage inputs and convert each to binary-coded decimal out-



SAGE Antenna at Alabama Site

Air Force AN/FPS-15 search radar at Tuscaloosa Aircraft Control and Warning Site, Ala., was developed by Sperry Gyroscope Co. and is part of SAGE network. Tower is 83 ft. high and antenna weighs nearly 70 tons. Facility is self-contained.

put at rate of 120 samples per second. Output is transmitted in parallel fashion with a parity check. New device provides conversion accurate to within 0.25%, or to within 0.1% as an optional feature, over temperature range of 0 to 75°C.

► **Deflecto-Analyst**—Digest of Literature on Deflecto, Volume 22, published by National Academy of Sciences-National Research Council, is now available from the Printing & Publishing Office, National Academy of Sciences, 2101 Constitution Ave. N.W., Washington 25, D.C. Price is \$5.00.

► **Telemeter Magnetron**, Inc., Los Angeles, has been awarded a contract to develop airborne digital programs for Project Vega. The \$400,000 contract covers development and manufacture of the airborne units plus ground-based checkout stations.

► **Supers on the Dotted Line**—Major contract awards recently announced by various manufacturers include the following:

► **Melpar** will develop and fabricate two-axis digitalized speech bandwidth compression system for USAF's Wright Air Development Center under \$550,800 contract.

► **Standard-Carbon Division** of General Dynamics Corp. will develop complete transverser single antenna communication system for Navy Bureau of Ships under a \$1.2 million contract. Equipment will be used for day-and-night and ship-to-shore communications.

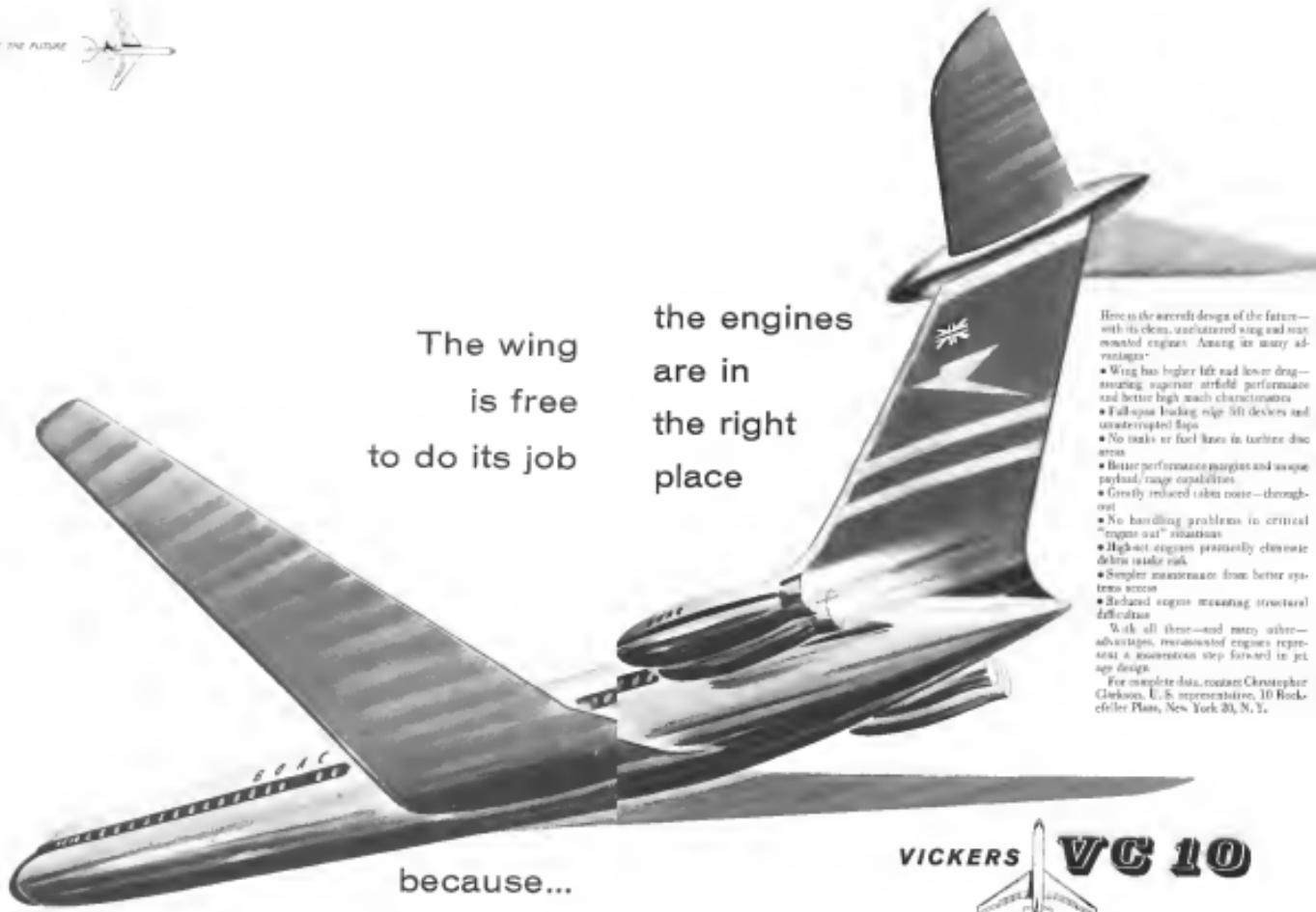
► **North America's Antennas Division** will design, build and flight test a full automatic altimeter landing system, including final approach, touchdown



The wing
is free
to do its job

because...

the engines
are in
the right
place



Here is the aircraft design of the future—with its clean, unobstructed wing and rear-mounted engines. Among its many advantages:

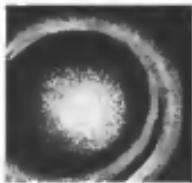
- Wing has higher lift and lower drag—assuring superior airfield performance and better high-speed characteristics
- Full-span leading-edge slat devices and uncambered flaps
- No tanks or fuel lines in turbine disc areas
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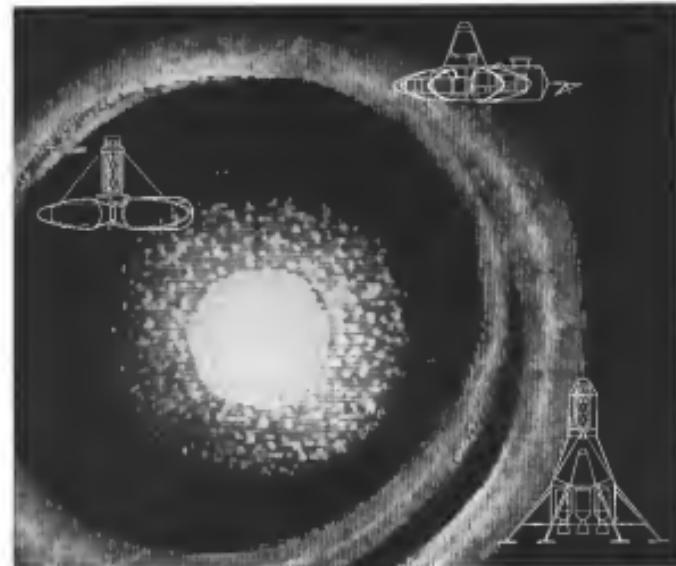
Beryllium Ball Used in Gyroscope

Ball of beryllium, a key part in a new gyroscope being developed by Minneapolis-Honeywell, is designed to spin at high speeds while held in position in a vacuum by electrostatic forces. It thus will spin without being slowed by friction.

and ramjet, lifting sail, and/or 5412, 600 award from Wright Air Development Center's Flight Control Laboratory. After Air Force tests, the AN/APN-134 (20A-1) in man will be delivered to Federal Aviation Agency in Atlantic City, N.J., for evaluation. (For details on the Antares system, see Aviation Week, Oct. 5, p. 113.)

• National Cash Register Co., Electronic Division, Bala Cynwyd, Calif., will continue its study of super fast magnetic disk switching and storage. It wins radio 570,000 contract awarded by Air Force Cambridge Research Center. The magnetic disk, which rotates approximately 800 rpm or 16,000 etc., has revolution switching speeds as small as 4 microseconds, company says.

• Bendo Aviation International Division reports a contract for much of 1959 dollars for aircraft equipment to be used on West German Air Force aircraft. Equipment, to be built by Elyria-Pioneer and Bendo Radio, is



New styles for the man-about-space



MISSILES AND SPACE SYSTEMS ■ MILITARY AIRCRAFT ■ DOUGLAS ■ CARGO TRANSPORTS ■ AIRCRAFT ■ GROUND SUPPORT EQUIPMENT

Every time a space traveler leaves home (Earth), he has to wrap himself in the complete environment necessary to his physiological and psychological well-being. Styling sealed space capsules to suit man's every requirement has been a major project at Douglas for more than ten years. Forty basic human factors areas were explored in these studies. Now Douglas engineers have evolved plans for practical space ships, space stations and moon stations in which men can live and work with security thousands of miles from their home planet. We are seeking qualified engineers and scientists who can add us in furthering these and other out-of-this-world but very down-to-earth projects. Some of our immediate needs are listed on the facing page.

Dr. Eugene Konecni, Head, Life Sciences Section, reviews a new concept in space cabin design with Arthur E. Raymond, Senior Engineering Vice President of

DOUGLAS

AIR

for supersonic wind tunnel supplied by
pressure tanks built of **USS "T-1" Steel**



It takes vast quantities of high pressure air to create a supersonic wind. These 12 tanks supply air at 600 psi to a 20-inch supersonic blow down wind tunnel at NASA's Langley Research Laboratory, Langley Field, Virginia. They were designed and built of USS "T-1" Constructional Alloy Steel by Pittsburgh-Des Moines Steel Co. Each tank is 60 feet long by 2 feet in diameter.

With such a large quantity of tanks and a specific size required, the problem in this design was to determine the most economical size and number of tanks to do the job. If made of standard boiler steel, the tank walls would have had to be nearly three times thicker than the 1/8" made possible by USS "T-1" Steel. With this three-times-stronger alloy steel, the tank walls are only 1/8" thick, compared with a requirement of nearly 2" thick if made of lower-strength material.

These vessels are good examples of the savings possible with high yield strength USS "T-1" Steel. Much less steel was required; there were vast savings in welding, foundations and volume—and, very important because of space limitations, there was a large reduction in ground space required. The vessels were designed to a working pressure of 60,000 psi and 90% proof pressure. The tensile strength of USS "T-1" Steel for pressure vessel applications is now 155,000 psi.

Now USS "T-1" Steel saves. These vessels required much less steel than normally used—but there was a steady reduction in freight costs. They required less material for foundations. Volume of steel metal was also drastically reduced. And they saved ground space in an area where available space was limited.

Why not find out what USS "T-1" Steel can do for you? Write United States Steel, 225 William Penn Place, Pittsburgh, 33, Pa., 15222 and "T-1" arrangements can be made.

United States Steel Corporation—Pittsburgh
Orville Basson Steel—San Francisco
Pittsburgh Steel & Pipe—Pittsburgh, Pa.
United States Steel—Hartford, Conn.
United States Steel Export Company

United States Steel



Tunnel Diode

Tunnel diodes are now being offered on a sampling basis to aviation manufacturers by the RCA Semiconductor and Materials Division. Photo shows one of the new diodes in its low voltage case.

Stock Transactions

Transactions for the periods July 11, Aug. 10 and Aug. 11-Sept. 10 include:

Boeing Technical Products Divided from 1,100 common shares to Thomas D. Schellhardt, vice president and director, and 1,000 shares to 12,200.

Kearfey Armament Inc. Acquisition of 1,200 common shares through exercise of options by 100 shareholders, and 1,000 shares to 1,100.

Standard & Western Airline, Elkhorn, Neb. 100 common shares by Arthur V. Sander, officer, trustee, a holder of 100 shares.

Standard Oil Company of 1,100 common shares. No bond holding and no options or warrants outstanding. No stock held by 100 shareholders, and 100 shares to 100.

Worrell Corp. Dividends of 1,100 common shares, 100 bond holding, and 100 options or warrants outstanding, and 100 shares to 100.

Worrell Industries Corp. Acquisition of 1,000 common shares by M. D. Corlett, officer, trustee, a holder of 100 shares, and 100 options or warrants, totaling a holding of 2,100 common shares, and 100 shares to 100.

United Industries Corp. Acquisition of 1,000 common shares by M. D. Corlett, officer, trustee, a holder of 100 shares, and 100 options or warrants, totaling a holding of 2,100 common shares, and 100 shares to 100.

Thomson-Kamm-Modular Inc. Acquisition of 1,000 common shares by M. D. Corlett, officer, trustee, a holder of 100 shares, and 100 options or warrants, totaling a holding of 2,100 common shares, and 100 shares to 100.

United States Steel Corp. Acquisition of 1,000 common shares by M. D. Corlett, officer, trustee, a holder of 100 shares, and 100 options or warrants, totaling a holding of 2,100 common shares, and 100 shares to 100.

United States Steel Corp. Acquisition of 1,000 common shares by M. D. Corlett, officer, trustee, a holder of 100 shares, and 100 options or warrants, totaling a holding of 2,100 common shares, and 100 shares to 100.

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For more information on the new Klixon High Temperature Precision Switch, write to Design & Development, Bureau, DID-FRSH-5.

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Competition Rises in Ion, Plasma Fields

By Philip J. Klein

Washington—Growing activity and increasing progress in the development of electric propulsion techniques to power rocket-launched, large-payload vehicles are interplanetary missions and/or to orbit stellar orbit, were reported here during recent meeting of the American Rocket Society.

The meeting also revealed the sharp competition between ion and plasma propulsion techniques, in terms of the trade-off between liquid and solid-propellant rocket engines. Most observers agree that it is too early to predict whether any technique will win out and many believe that both probably will find space propulsion roles.

New Developments

Two are some of the recent electric propulsion developments cited by ARS speakers:

- **Colloid electrode plasma accelerators**, developed by Lockheed's Missile and Space Division, has demonstrated an

effective specific impulse of more than 2,000 sec, based on measured specific impulse and propellant mass. Lockheed has achieved maximum particle velocities of 86,000 meters per second and impulases of nearly 2,000 dimensionless, according to S. W. Kulu and W. L. Scott of Lockheed's Basic Physics Department. Efficiencies of more than 30% have been achieved under some conditions and a figure of 50% appears possible. Using plasma produced by electrode erosion, Lockheed scientists predict that effective specific impulses of 6,000 sec should be realizable.

- **Cesium ion motor**, developed by North America's Rockwell Division, has allowed beam power level of 177 watts per square centimeter of anode area, with thrust levels of 5.6×10^{-10} lb./sq. in. Max radiation studies indicate that 70% of the cesium reaches the anode. The energy of high energy ions and that over 90% was retained at the surface anode. To maintain the ion beam, electrons were injected by a thermionic emitter near the motor's

exit aperture with the electrons being accelerated by the ion beam space charge according to a report presented to C. G. Dugger of Rockwell and R. C. Speier and A. T. Fannier, of Electro-Optical Systems, Inc., Pasadena.

- **Ion-jet engine using hydrogen** has achieved specific impulse of 1,900 sec in experiments at California Plasma Corp., according to a report by A. C. Boretz and G. L. Case. The Plasma Div. inventors report that system with cathode and anode coating, designed to enable electrodes and nozzle to operate at temperatures over 1,000°C are now being designed. Work in date indicates that operation in the arc chamber should be one atmosphere or higher to achieve reasonably good efficiency in converting electrical energy into free ion kinetic energy.

- **Experimental ion engine** now in operation at Electro-Optical Systems, Inc., which operates under joint research participation in the propellant, has achieved beam currents of 12 mA and



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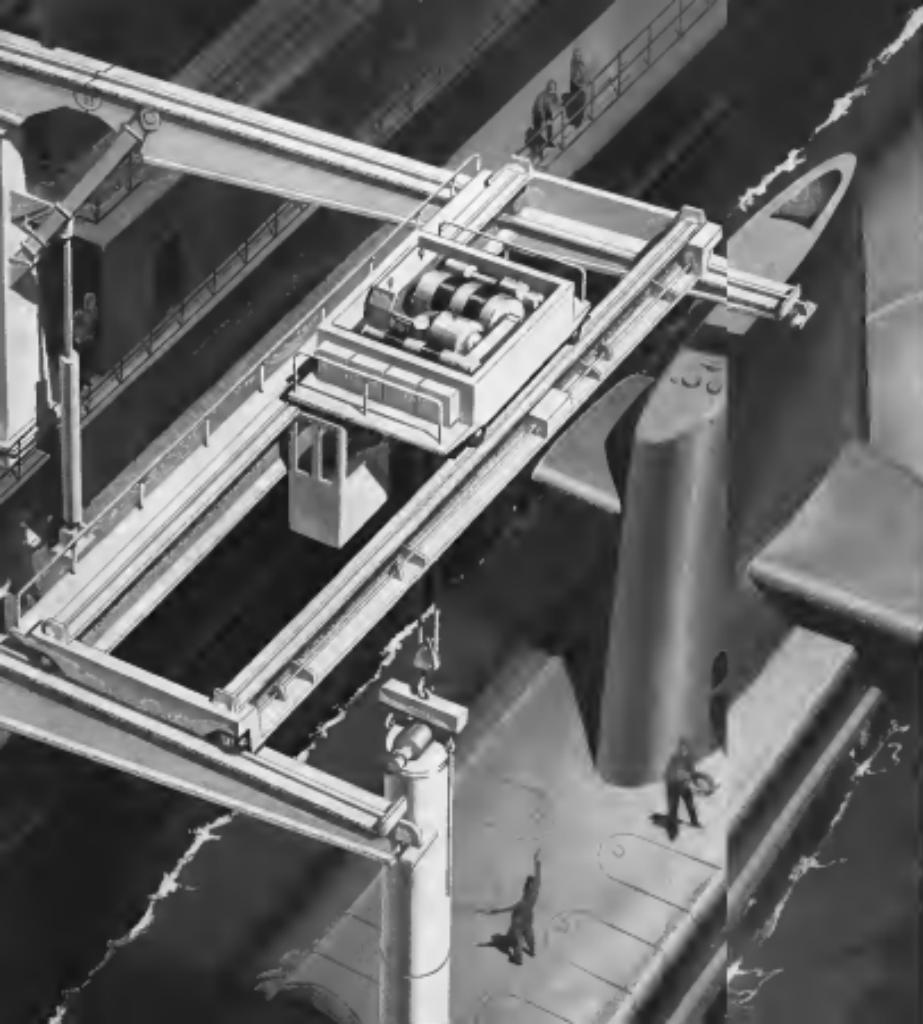
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Mercury Tunnel Tests Under Way at AEDC

Multi-exposure photograph of 32% scale Mercury capsule model test vehicle during wind tunnel tests at U.S. Air Force's Arnold Engineering Development Center's transonic test section. Data is gathered in transonic speed range from Mach 3 to 1.5. The model at right shows the capsule at a 45-degree angle to AEDC's Gas Dynamics tunnels. Run lasts for about 1/6 sec., smaller model at lower left shows the photo records reconstructed for purposes of comparison. Cobaltite gimbals are firmly stable.



Threading the needle with a POLARIS missile using Westinghouse Load-O-Matic controls

Each POLARIS missile from a tender into the launching silo on a mobile submarine takes a handling system that combines ruggedness with extreme maneuverability and safe, sure, precise control—control that the POLARIS sees to fit in the air as it swings smoothly and gently into position in the submarine.

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PROBLEM:

Measure angular acceleration accurately

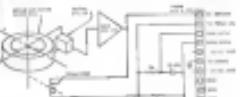
ANSWER:

The New Donner Angular Accelerometer

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THE FACTS... As you are well aware, designing a good angular accelerometer is a tough technical task. Donner Scientific's new unit is another successful chapter in a record of creative engineering.

Chief applications for this unique force-balance angular accelerometer are closing the servo loop on guided launching equipment for missiles and detecting the roll, pitch and yaw accelerations of missiles once they are airborne. In the latter application, the Model 4535 can replace more gassy and supplement others.



Circuit diagram of Donner's new Model 4535 Angular Accelerometer.

Donner's rugged new angular accelerometer weighs only 2 pounds.

The Specs

RANGE AVAILABLE
 From ± 4 radians/sec to ± 50 radians/sec to very intermediate ranges.

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OUTPUT, FULL SCALE

± 20 Volts ± 10 cps sine full scale

LINEARITY 0.1% full scale

HYSTERICSS Less than 0.01% full scale

DAMPING 0.6 to 0.1 of critical

RESPONSE 3.1°/second $\times 3.1^{\circ}$ high

WEIGHT 2 pounds

DONNER SCIENTIFIC COMPANY CONCORD, CALIFORNIA

Electric Propulsion for Space

Electric propulsion for space vehicles achieves a very high specific impulse by using a propellant of ionized gas which is accelerated electrically to extremely high velocities. Several basic types now under investigation, as reported at recent American Rocket Society meeting, include:

• Ion propulsion employs propellant consisting of a stream of positively charged ions. These are accelerated by a beam and accelerated by electrostatic fields using induction similar to those existing in a cathode ray tube to focus and direct beam of electrons.

• To prevent build-up of negative charge on space vehicle and to prevent blocking effect due to space charge, electrons would be separated into two beams at a lower space vehicle to neutralize an charge.

• Plasma propulsion uses a neutral (no charge) plasma of propellant which is accelerated and directed by means of external magnetic fields which react with field produced by current flowing through the plasma. Technique involves some of the same principles under investigation for electrical power generation.

• Arcjet propulsion uses an electric arc discharge to produce sudden heating of propellant gas which expands in a specially shaped nozzle to form a high velocity jet. This type of engine does not use external magnetic fields to augment propellant velocity.

• Blasted gas propulsion explores a gas, such as hydrogen, whose energy level is raised by passing it through an electrically heated nozzle heat exchanger.

A thrust of 65 dynes, when generated with potassium, Soviet Narkhich reported. Company has developed new technique for controlling and intensifying ionization at alkali vapor flux fed to the ion chamber in which the vapor is electrically diffused through a membrane.

Both ion and plasma engine techniques are under investigation by the National Aeronautics and Space Administration's Lewis Research Laboratory in Cleveland. Primary emphasis is on the ion engine, because its operation is believed to be more reliable and more easily made predictable, according to NASA engineer W. F. Meinel and W. D. Boyle. However, there is strong interest in plasma investigation.

Propulsion Principles

Although proponents of ion and plasma engines disagree on ion speed, there is general agreement that at the present time the principles of ion propulsion are better understood than those for plasma propulsion. Design of an ion engine can draw on existing know-how developed for the design of electron and microwave tubes. The design of a plasma engine is much more dependent upon extensive iteration experiments, because of the present inability to predict the complex interaction between ion and magnetic-electric fields and the plasma.

It also is generally conceded that an ion engine can produce a higher specific impulse than a plasma engine, because it can accelerate particles to higher velocities. Specific impulse is a measure of the thrust achieved per pound of propellant per unit time.

However, Lockheed's Kach and Stoen, both proponents of plasma engines, point out that there is another impor-

tant factor to consider—the total thrust developed per unit area, referred to as "specific thrust." A low specific thrust involves a weight penalty because of the additional structural supports, propellant feed lines and radiating surface required.

The Lockheed scientists point out that a plasma engine has a specific thrust that is at least 100 times greater

than that of an ion engine because of inherent limitations imposed by voltage breakdown considerations in an engine that uses electrostatic fields for particle acceleration.

However, a report by David B. Longman of Thompson Ramo Wooldridge and Bernard K. Geiger of the University of California at Berkeley suggested that the specific thrust of an ion engine can be increased through the use of a series of accelerating electrodes, each of which contributes to the total thrust. They conclude that there are many "reasonable" practical difficulties associated with plasma engines, but they believe the concepts are promising and worthy of further investigation. Added advantage of the technique is the ability to achieve useful thrust levels with a low aspect ratio, or ratio of beam diameter to acceleration distance required.

Unit Weight

The weight of an ion or plasma propellant unit will be small compared with the weight of the nuclear power plant needed to supply it with the required electrical power. For example, the SMAP-2 nuclear turbo-electric power generation system now under development will weigh about 2,000 lb. in the 10 kw. version, around 3,000 lb. in the 60 kw. size.

Thus the efficiency with which the



Gravity Locator Used in ICBM Tests

Instrument to measure the mass and center of gravity on three axes of the Air Force Titan and Minuteman intercontinental ballistic missile uses mass has been developed by Dynamics Corp., Holloman, New Mexico. Device performs instant of weight and CG along with pitch and yaw axes during reentry and is used primarily in pre-flight tests at wind tunnels. Company says the device has an overall accuracy of 0.0001 in. over an operating range of 1,000-4,500 lb. Unit is air transportable for field testing.



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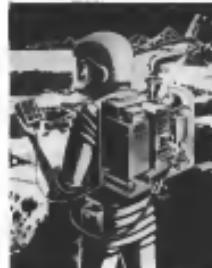
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Space Oxygen Unit

Closed circuit oxygen system carried on an astronaut's back to provide breathable air has been designed by Arcturus Metals Division of the Grant Corp. Unit weighs 10 lb., stores 6 hr oxygen supply.

propulsion unit requires electrical energy and thrust will be an important consideration. Generally, the more energy is given, at least in a slight increase in the plasma engine's efficiency, although Lockheed's Kistiak and Stasik believe there is no reason to believe that the two won't be comparable in that respect.

The ion engine requires several voltage supplies whereas the plasma engine requires only a single high voltage sig. ph. However, since plasma engines it quite a number of capacitors to store up the high energy required for current discharge through the plasma.

Thrust Control

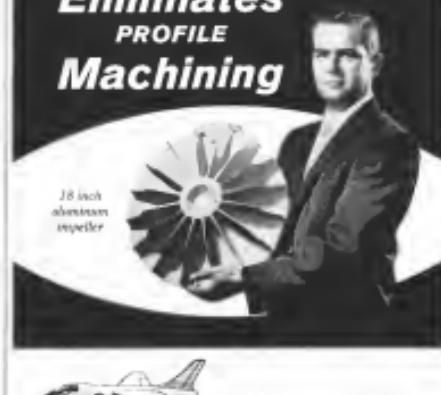
The ion engine normally is caused and a continuous operation device is which thrust level is controlled by the amount and/or rate of which gas is fed to the plasma. Several plasma engines are recently mentioned and others are pulse-type propulsion units in which applied thrust is controlled by varying the firing rate.

Ability to operate reliably over extended periods of time measured in months or even years will be an important criteria for selecting an optimum chemical propulsion system. At the present stage of development it appears promising to predict whether ion or plasma engine will have a decided reliability advantage over the other.

Here are some of the decisive propulsion investigations under way at Lewis Research Center as reported by NASA's Marshall and Davis.

• Electro-thermal properties: NASA has launched a small air jet research project to investigate possibilities of utilizing

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18 inch aluminum impeller



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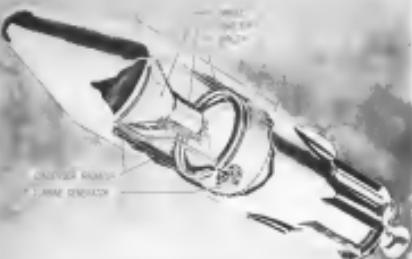
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SNAP II Nuclear Reactor Flight Concept

Flight configuration of SNAP II small nuclear power system experimental reactor (AIA Nov. '80, p. 17) is shown in the concept by Atomic Energy Division of North American Aviation, Inc. Reactor produces 90,000 watts of heat and weighs 210 lb.

turning efficient, long duration electric net at the pretension and power levels suitable for space propulsion. Agency also is investigating use of radio frequency fields for heating propellant gas. Helium, used as the working fluid, is introduced into a tube which is heated by an RF coil that is fed by a 10-watt, 1-kw power supply. Tests to date indicate that the RF energy does produce internal heating but NASA has not yet obtained quantitative data on the efficiency of energy transfer to the gas.

• **Translational accelerator.** Acceleration of plasma in a tube is the result of a series of tests spaced along the tube which are conducted in polyphase RF cavity to as to produce a magnetic field or magnetic mirror which appears to accelerate down the tube. This is under investigation. Using a 1-kw single-phase power supply for only tests, NASA found that velocities of 10,000 meters/sec could be achieved. Furthermore, tests using a three-phase 40-kw power supply, are aimed at determining jet selection, gain, thrust and efficiency as well as nature of instabilities. Propellant methods to be used in experiments include lithium and nitrogen.

• **Crossed-field accelerator.** One of several possible systems for obtaining plasma acceleration through the use of crossed electric and magnetic fields which NASA is investigating employs the plasma as a conductive carrier current source in a crossed-field accelerator. Tests are being carried out on the plasma. Tests to date on a cell-type accelerator indicate that velocities of about 10,000 meters/sec are obtainable.

ergy stored in capacitors be available for plasma heating.

Lockheed's plasma propulsion experiments were carried out using a pair of cylindrical electrodes connected to a low inductance, high energy capacitor to supply discharge energy. Leads between the electrodes were arranged to maintain low inductance and to ensure direction of discharge focus.

With the capacitor charged to a high voltage and the region around the electrodes evacuated, discharge is initiated by introduction of plasma between electrodes. In one set of experiments, plasma was produced by exploding a fine wire suspended between the electrodes at right angles to the plane of the discharge circuit. In a second set of experiments, a discharge was produced by introducing a thin layer of argon gas between electrodes with subsequent electrode heating under discharge conditions producing the major portion of the plasma.

Magnetic fields produced by the large current in the discharge and the nearby circuit elements accelerate the plasma. The magnetic field of the opposing current in the lead

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This step-down photo shows how the Convair 880 is fueled.

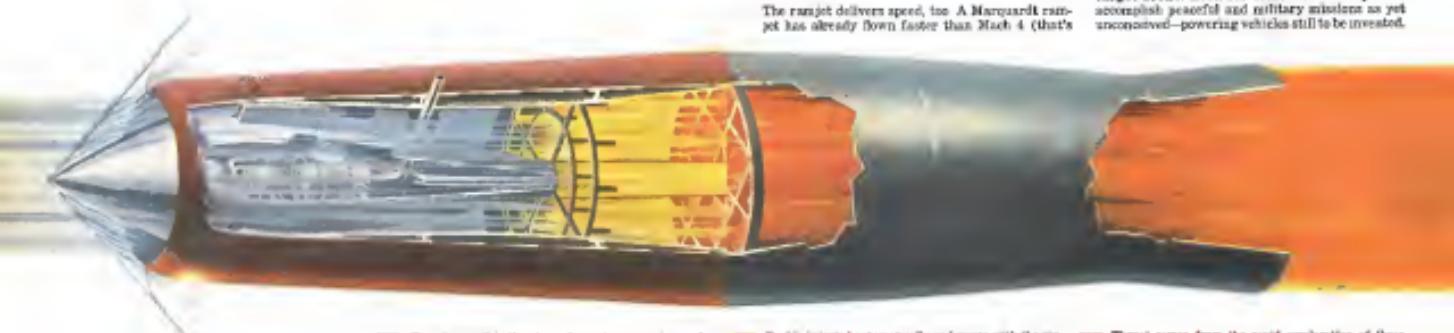
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TOMORROW RAMJETS WILL POWER:



The NAVF LOCKHEED KINGFISHER supersonic target drone (top) uses a ramjet Marquardt rocket to fly missions at almost four times the speed of sound.

INTERPLANETARY VEHICLES.

America's first interplanetary explorer may be launched into orbit via Marquardt Mariner. Despite breakthrough in the art of rocket technology, its consumption of conventional rocket fuel makes it impractical to send nuclear and ramjet advantages

The ramjet family of engines for aircraft, missiles and space vehicles is unique because of its simplicity of operation. Without moving parts in the basic engine system, the ramjet develops compression ratios of more than 100 to 1 at 3500 miles an hour—yet can use kerosene as fuel. By comparison, your piston-engined car needs "super-premium" gasoline for compression ratios of only 10 to 1.

Now compare the ramjet with the rocket engine. The ramjet can get along on 1/10 the propellant consumption of a rocket. That's because rocket engines must carry along their own oxidizer, while the ramjet accepts its oxidizer from the atmosphere.

The ramjet delivers speed, too. A Marquardt ramjet has already flown faster than Mach 4 (that's

four times the speed of sound, or about 2,600 miles an hour)—and a ramjet speed of over 15,000 miles an hour are feasible. By contrast, turbojet engines—the powerplant powering today's 600 mph jetliners—are limited to speeds in the Mach 3 range. By eliminating the moving parts turbines need to develop compression, the ramjet delivers greater speeds and reliability—costs less to make, operate and maintain.

That speed and reliability, along with its efficiency, is why today's ramjets are making significant contributions to America's defense effort—powering two front-line defense missiles and a sophisticated target drone. Look for tomorrow's ramjets to accomplish peaceful and military missions as yet unenvisioned—powering vehicles still to be invented.

Thrust comes from the rapid acceleration of these gases through the engine. This action pushes the entire ramjet—and the vehicle it is carrying—forward at ever-faster speeds.

THE *Marquardt*
CORPORATION

Founded in 1944 to pioneer in developing the ramjet as a basic powerplant, Marquardt today employs more than 5,000—of whom more than 1,000 scientists, engineers and skilled technicians—in the fields of advanced space research, power systems, controls, mechanics, aircraft training, research facilities, weapon systems support and manufacturing.

For a reprint of this advertisement you are invited to write: Roy R. Marquardt, President, The Marquardt Corporation, Corporate offices: Van Nuys, California.



AIRDROP TO THE "LOST BATTALION"

Looking gently, the big biplane dropped down out of the low clouds, braving a sudden burst of enemy gunfire, and landed over the hills, less than wounded terms. Glancing back at his observer, the pilot nodded to the ground. The observer began dropping packages over the side. Smoke from below, hidden in the dense village and undergrowth of the Argonne Forest, had surrounded an all sides by Germans, lay the injured and dying men of America's "Lost Battalion."

It was October 6, 1918, the date of the first aerial supply drop in combat history.

With its plane completed, the two sister DH-4 landed back to their base home base of the A.E. 1's 30th Aero Squadron. At the

controls was Lt. Harold E. Gostler, a flight commander from Chicago. His observer was Lt. Erwin R. Bleeker of Wichita. Later in the day Gostler and Bleeker took off on their second mission. They never came back. Ground fire sent them crashing to their deaths near Bapaume, France.

The story of the "Lost Battalion" is today more legend than fact. Actually, the men were never lost. A battalion of the 77th "Steel Division" Division and parts of a machine gun battalion were cut off after a rapid advance beyond the front lines during the Meuse-Argonne offensive.

With its plane completed, the two sister DH-4 landed back to their base home base of the A.E. 1's 30th Aero Squadron. At the

four days they were ravaged by hunger, fear and death and subjected to continuous enemy attack, including a barrage from their own artillery.

On October 6, the 30th Aero Squadron, which had flown its first mission only three weeks before, was called in to airdrop supplies. The squadrons flew 13 missions the first day. Coordinates were sent from the "Lost Battalion" by carrier pigeons, giving the Battalion's location, proved in sight but without error and the trapped men received only a fraction of the supplies. Finally, however, an airdrop team spotted the correct position and the remaining men were rescued on October 7.

The planes used in history's first recorded airdrop were DH-4s designed by Geoffrey de Havilland, the famous British designer. In the four years of the war, 4,700 of the big British planes were built under license in the United States. Rugged, fast and reliable, the DH-4 was at some point in its career, utilized for every conceivable type of duty. In its original production form the DH-4 was powered by a 240-hp. RHB engine to a top speed of 120 mph. The somewhat later American version, powered by a 400-hp. Liberty engine, had a top speed of 125 mph.

Because its main fuel tank was located between the pilot and the observer—directly in the line of enemy fire—the DH-4 was labeled the "Floating Coffin," but it was more vulnerable in this fashion than other aircraft. Its armament consisted of two synchronized forward facing Martini machine guns and a special mounted Lewis machine gun. The DH-4 was still in service in 1932 when Harold Gostler and Erwin Bleeker were posthumously awarded Congressional Medals of Honor. DH-4s similar to the ones they flew to successfully accomplish in U.S. military and government service for almost another decade.

HERITAGE OF THE AIR

One of the most inspiring chapters in the history of technical evolution is the story of the men and flying machines of World War I. It is the highly personalized story of brave men—and the wives, wife, sons, and rudimentary technologies that converted manpower to airpower. Today, Leach Corporation celebrates its 40th year in electronics with the presentation of this *Heritage of the Air* series.

Leach credits Col. D. F. Moran, Jr. (Ret'd.), Commanding Officer of the 30th Aero Squadron, during the same war, for his help in preparing this narrative.

Technical Director by Courtesy of the Air Force
Major Kenneth S. Brown, USAF

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SINCE the establishment of our business in 1919 it has been our intent to source and maintain the good will of every customer using our equipment, by supplying units of the finest quality—properly designed, accurately manufactured and carefully assembled. "We are constantly designing, developing and testing, with two objectives in view. First, to make our initial expense in every respect, and Second, to have new types and designs ready for each new requirement as the electrical industry progresses. Realizing that an electrical control scheme is so better than any other used in it, we consider the design and materials first, and the cost last. Although we have many varieties of designs, we never sacrifice the quality of any type in meeting competition. We value your relay business and feel justified in saying that "The more you use Leach Relays, the more you will be convinced that they have created new high standards in accuracy and dependable performance."

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A HERITAGE IN ELECTRONICS

Val Leach, founder of Leach Corporation, wrote the above advertisement 75 years ago. In it Mr. Leach laid down a business philosophy that is as valid today as it was in 1933. He knew there would be no room for "yesterday's heroes" among the companies supplying the vital, growing electronics industry. He knew that success would be in direct ratio to uncompromising product reliability. And he also knew that technological progress could only be based on the solving of tomorrow's problems.

This year Leach Corporation celebrates its 40th anniversary in electronics with a reaffirmation of Val Leach's time honored principles: Solving problems at the core of the Leach philosophy of doing business. Leach will continue to base its success on anticipating customer needs and meeting them with advancements tailored to specific requirements.



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Pyrographite May Cut Nose Cone Heat

Waltham, Mass.—New form of graphite with controlled crystal orientations that gives it novel thermal, electrical and other properties, may enable ballistic missile nose cones and reentry capsules to operate at higher temperatures (AW Nov. 16, p. 37).

Oriented graphite has been produced in small quantities in research laboratories for more than 50 years, but can be produced in commercial quantities by the process developed by Battelle Co. with the partial sponsorship of the Navy's Special Projects Office.

A pilot production facility has been constructed by AiResearch in Lawrence, Mass., which will be capable of accepting forms or sandwiches in shapes ranging up to 17 in. and is placing the equipment of a full scale facility capable of handling larger shapes and producing greater quantities of the material.

Problems still await in adapting the process to such large scale production, but these are under active investigation by the company.

Called "Pyrographite," by Battelle, the material is superior to the same temperature as normal graphite (approx. 6,100°F), which is the highest temperature limit of any electrical conductor. Thermal and electrical conductivities of Pyrographite, moreover, is stronger anisotropic—that is, it is higher by several orders of magnitude in a plane parallel to the surface than at right angles to it. Battelle claims also that the material has the properties of high density and impermeability to gases.

In the new process,ankalides of carbon or graphite are obtained from a carbonaceous gas and deposited on a substrate (base), with controlled crystal orientations. Pieces formed entirely of Pyrographite can be produced by deposition on the outer surface of a graphite crucible, which is then melted away from the workplace.

In the plane parallel to its surface, Pyrographite has a higher heat conductivity than copper, while at right angles its conductivity is lower than normal graphite and, also, lower than some low-conductivity ceramics. Certain materials commonly increase in thermal conductivity above some characteristic temperature because of the contribution of radiation to thermal conductivity. Battelle says that no such contribution has been shown to date for graphite or Pyrographite, which makes the thermal insulating properties of Pyrographite compare even more favorably with those of conventional solid thermal insulators. This contention, the company says, has been verified by very high

temperatures are plasma and melt cut-off tests.

Other properties are:

- Electrical. Results of initial tests indicate electrical conductivity properties of the new material are similar to the thermal characteristics. Resistivity at right angles to the surface increases with higher prepreg temperatures, while it decreases in this direction parallel to the surface. The resistivity at 1,000°F is 1.4 ohms per square centimeter, and at 2,000°F, 0.4 ohms per square centimeter. The increase in the layer plane is considerably greater than in normal graphite, which is considered a poor conductor, across the layer as it is for greater than for graphite.
- Density. A significant property of the material in comparison with normal graphite is its high density. The theoretical density of normal graphite is 2.26 grams per cubic centimeter; oriented graphite ranges from 1.6 to 1.7, while deformed graphite runs from 1.7 to 2.0. Pyrographite has been pressed with densities as high as 2.27. Density increases with the temperature of prepreg because of a higher degree of molecular orientation at higher temperatures.

- Mechanical properties. Strength-toweight ratio of the material is higher than for Simes 110 standard steel at low temperatures while above 2,000°F, while normal graphite has one of the highest strength-to-weight ratios known. It has a ratio five times as great as carbonized coal graphitic and only graphitic and coal graphitic have higher strength ratios. Graphite produced in a high vacuum, high temperature, rotating stream of solids and gases resulting in a light coating of the oriented graphite, compared with normal graphite. This property is attributed to the oriented carbon lattice which presents lower-area contact basal plane to the gas stream, which increases the strength of the graphite.

• Durability. A significant property of the material in comparison with normal graphite is its high density. The theoretical density of normal graphite is 2.26 grams per cubic centimeter; oriented graphite ranges from 1.6 to 1.7, while deformed graphite runs from 1.7 to 2.0. Pyrographite has been pressed with densities as high as 2.27. Density increases with the temperature of prepreg because of a higher degree of molecular orientation at higher temperatures.

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Graphite, due to its high density and low atomic number, is frequently used as a moderator in nuclear reactors. Oriented graphite is denser than normal graphite, so it presents the advantage of being able to use more atoms per unit volume for moderating neutrons. Because the material is extremely porous, Battelle says, it requires



PYROGRAPHITE, an elemental material consisting of a graphite crystallite dispersed in a highly oriented matrix, with basal plane load free drift. The more drift at right angles to a base through a sheet of asbestos. The material can be deposited on a substrate (base) or as a free-standing graphite wafer.

SMALL APPETITE NOISE SOURCES

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Until recently signal simulators for monitoring radar receivers at aerospace facilities were of two types: one was a big and heavy analog source with cumbersome auxiliary equipment, and the other was a miniature, though delicate instrument, rentable only for the laboratory.

We call your attention now to the Litton 2000 series of miniature gas noise sources. The Litton 2000 for waveguides is pictured above. It has a flat front, the Litton 2002 designed for coaxial cable use. We call your attention because most tubes in this series are now in production and we suspect there are frustrated design engineers who will appreciate this announcement with keen interest.

Our gas noise sources may properly be called miniature. They require only inches of space, smaller, lighter auxiliary equipment, and small voltage and currents. Around 300 radio frequencies, 100 milliwatts maximum, these. These characteristics, plus others, have caused them to find numerous applications for on-flight calibration and test of aircraft

microwave receivers, or electronic testbeds on airborne radar systems, and in other systems which require various measurements in vibration, shock, humidity, and temperature cycling.

The Litton family of miniature gas noise sources, like all Electron Tube Division products, was designed to solve specific end user functions. We have found that this philosophy contributes to customer reliability: tubes do their job more efficiently, for longer periods of time, and at lower overall cost to the buyer. Other advantages also result. For example, these noise sources require no spacers and the L-2000 is replaceable in the field without changing the mount.

Specific frequency ranges in L, S, C, V and K bands are covered. If you are concerned with radar transmission, or with microwave data links of any kind, call, write, and we can now inform you. Write to Litton Industries Electron Tube Division, Salt Lake Plant, Office A10, Salt Lake City 30, Utah.

no further punishment for reactor operators and illustrates the problem of potential poisoning from impurities found in ordinary graphite.

Because it is inexpensive to process, the company points out, it can also be used as a coating for fuel elements to keep plutonium fission products out of the coolant stream, while its strength at high temperatures will enable it to contain unpredictable pressures of fission products.

Production Process

The process of producing Pyrographite on a commercial scale, the company adds, has reached the point where it is now possible to rapidly deposit layers of carbon on a substrate with wall thicknesses up to one-half inch. This can be as a substrate or a continuous graphite form. The process is based on high temperature pyrolysis of carbon containing vapors.

The development and pilot production work to date has been with resistance or induction-heated furnaces capable only of preparing samples for property measurement and small commercial passes. Because the degree of orientation of the material is highly dependent on the temperature during deposition—over a temperature range extending above 2,000°C—process control problems increase rapidly with increasing use of production pieces.

The most obvious structural difference between Pyrographite and natural graphite is the degree of orientation of the graphite planes. This is the striking of the basal planes.

In the crystallites of natural graphite, each layer has a well-defined position relative to the neighboring layers, whereas in Pyrographite the stacking of the layers occurs in a random fashion. The randomness in layer stacking destroys the periodic repetition of atom positions at right angles to the basal plane so that the structure can no longer be described as a repetition of unit cells. It is this difference in structure that gives Pyrographite its difference in mechanical, thermal and electrical properties.

Rocketdyne Develops Portable Solid Plant

McGregor, Tex.—Continuous processing pilot plant for making solid propellants is going into operation later at the solid rocket plant of Rocketdyne Division of North American Aviation, Inc.

Quadratic pilot plant was trucked here from California on a 30 ft trailer, and this mobility demonstrates the potential field loading capability of the system. Plant has a maximum curing capacity of 500 lb. per hour, and a maximum of 5,000 lb.

Scientists to Discuss Space Trajectories

First symposium on space trajectory determination, covering fundamental theoretical concepts and applications, will be held Dec. 14-15 at the Langley Research Center, Hampton, Va.

Speakers include Keith A. Morris of Systems Division of General Dynamics Corp., and Dr. C. A. Whitney, Smithsonian Astrophysical Observatory.



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Paint Gives Missiles Thermal Protection

By Michael Yaffee

St. Louis, Mo.—Thermal protection that can be painted on missiles to the exact temperatures required is now being offered to engineers by Emerson Electric Manufacturing Co.

The protection, which comes in the form of a family of tailor-made sublimating paints, is offered at a low cost, lightweight means of controlling the high temperatures induced in missiles and space vehicles by atmospheric friction, solar heating and rocket exhaust gases.

To date the material has been used on the nose of the Honest John rocket and it under evaluation as a coating for the reentry capsule in an advanced version of that rocket now under development. The material is also being evaluated for the Little Joe capsule, the Project Mercury capsule and, potentially, in all three stages of the Minuteman missile.



RESONANCE SUPPRESSOR BEFORE FIRING
MATERIAL: ALUMINUM
THERMAL PROTECTION: "THERMO-LAG"-.015"



RESONANCE SUPPRESSOR AFTER FIRING
MATERIAL: ALUMINUM
THERMAL PROTECTION: "THERMO-LAG"

SOLID PROPELLANT rocket resonance suppressor made of aluminum and coated with Thermo-Lag, is shown here before and after 1.6-sec exposure to 4,300F at 1,000 ps

psi, says Feldman, there is no limit to the sublimation temperature that can be built into the basic Thermo-Lag formulation through the use of temperature elevating or depressing agents.

Material's Composition

Essentially, Thermo-Lag consists of inorganic salts in organic and inorganic binders. It is mixed and applied like a paint by either spraying or dipping. Emerson is currently working on a Thermo-Lag formulation that will have structural strength as well (being it as a matrix in a laminated structure or as a filler in porous matrix) but this is in a very early stage of development. One of the principal attractions of the Thermo-Lag formulations is that the material can be used at approximately room temperature, around 50°F. This means that it can be used to coat live rocket motors and solid engines.

The fact that the material can be applied like a paint is also important. It means the material can be used on odd-shaped and otherwise difficult-to-coat structures. It was one of the main considerations in NASA's interest in the material for the Little Joe capsule.

How It Works

In a somewhat simplified manner, that is how the 230F Thermo-Lag formulation works. As heat is generated, it is absorbed by the Thermo-Lag coating until the coating reaches its sublimation temperature, at this case, 230F. The amount of heat absorbed will depend, of course, upon the amount of coating. Roughly, it will take 47 Btu to raise the temperature of one pound of 230F Thermo-Lag 1F.

When the temperature reaches 230F, the Thermo-Lag sublimates. In going from a solid to a vapor state, each pound of the coating absorbs another 380,583 Btu. Then the exposed coating has to work its way through the interface to the boundary layer and then takes up more Btu. The vaporized coating thins the boundary layer, serving as a gas shield to further protect the underlying structure from heat. At extremely high temperatures, the porous Thermo-Lag will come to the surface and then burn more heat.

Overall, one pound of Thermo-Lag will absorb about 5,000 Btu from the first heat input to final decomposition. At this figure, says Feldman, will go with the rate of heat input. The more heat that is applied, the greater

the amount of gas that will form. (Rate of heat transfer to the material and the thermal conductivity of the material will determine the thickness of the coating that will sublimate.) The greater the amount of gas formed the greater the change required for them to diffuse into the boundary layer and the thicker the boundary layer becomes. Consequently, says Feldman, the overall figure could become 15,000-20,000 Btu absorbed per pound of Thermo-Lag at 230F per second and one of 2,000-3,000 Btu/hr/ft². When the Thermo-Lag coating is gone, the underlying material is exposed at or close to the sublimation temperature of the specific formulation chosen. For the Little Joe capsule, FARIS, knowing that 180°F was the top temperature the plastic body could withstand, chose the 230F Thermo-Lag formulation for the propellant.

For the Dyna-Soar, it is expected that NASA will need a material that will sublimate at 1700F, and Emerson is likely to start work on a Thermo-Lag formulation to meet that high temperature requirement.

Determining Thickness

Once the top permissible temperature for the structure is determined and the right Thermo-Lag formulation selected, the next step is to determine the thickness of the coating required. From the trajectory profile of the mission the vehicle will have to perform, heat input can be determined for each interval of the flight. In one five-second segment of the trajectory, for example, heat input to the vehicle may be 100 Btu/lb/sec or a total of 300 Btu/lb.

From the chart of the selected Thermo-Lag formulation, say the 230F coating, it is learned that the material can absorb 7,000 Btu/lb at the rate of 100 Btu/lb/sec. Dividing 300 Btu/lb by 7,000 Btu/lb gives 0.07 in/lb for the segment of the trajectory. Then, dividing 0.07 in/lb by 70 lb/in², the density of the Thermo-Lag coating, gives the required thickness of .005 in. or .012 in. Adding the results from each segment of the trajectory will then provide the total thickness of the specific Thermo-Lag insulation required.

Weight Savings

By thus tailoring a protective coating to a specific application, says Feldman, it is possible to realize important weight savings. In addition, the material has high thermal shock resistance, as one demonstration, at went from ambient temperature to 4,300F in 15 milliseconds successfully. In the case of the Honest John resonance sup pressor which fits inside the solid propellant grain and it contains a control strut structure, says Feldman, Thermo-Lag makes possible the substitution of



WORKER SPRAYS nozzle interior of Honest John rocket nozzle with Thermo-Lag (above). Coating is dried and cured (below) with relatively simple setup of 375 watt infrared lamps (shown) in ring around heated station.



THERMO-LAG jacket on Honest John nozzle remains intact after impact of the rocket body is tested to provide greater surface area.





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Rodstone's Mercury Role

Washington—Testfire schedule for use of the Rodstone missile in National Aeronautics and Space Administration's manned capsule project now calls for six shots without animal life, six carrying a chimpanzee in the capsule and the eighth and last carrying one of the seven Mercury space pilots. Flying probably will not begin before early spring. A second plus being discussed is to fire three capsules, empty except for instruments, then place a chimpanzee in the fourth, and put space pilots in the last four capsules when further knowledge is available on reliability.

an aluminum structure, with a sustained weight reduction of 50-75%.

Used on the outside of the Honest John missile, Thermo-Lag serves the same function as a water jacket (but as an ablative coating) without the weight or complexity of enclosing the missile's metal temperature. In this application, the Thermo-Lag jacket is seen to provide additional protection for crew and passengers from the coating gases and to better enable the jacket to expand with the missile.

Radiant Emission

In applications where radiant emission becomes a significant factor, it is also possible to vary the index thermal conductivity of the Thermo-Lag coatings to the proper choice of formulation without basically altering any of the other physical or thermodynamic properties of the material.

But one of the most important attractions of Thermo-Lag, says Feldman is the fact that sublimation temperature is not a function of the rate of heat input.

This characteristic, he believes, makes Thermo-Lag superior to ablative coatings (such as materials like Teflon and silicon) currently being used on some missile nose cones.

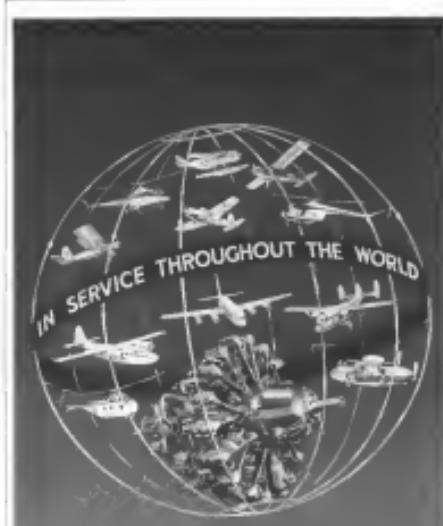
Not All Extrusions

More potential uses of Thermo-Lag however, are not quite so enthusiastic as Feldman. The material is still a comparatively new development and as such admittedly has not yet reached its full potential nor indeed all its characteristics. For one thing, Thermo-Lag is hygroscopic and, in the event of a rain just before launching, could pick up enough moisture to interfere with the flight of a vehicle early in the flight. So the fortification of its electronic equipment NASA has made some effort to develop a vinyl or rubberized protective coating that could be applied over at least and leave the Thermo-Lag clean and dry.

Hawker-Siddeley, Nord Enter Into Missile Pact

Paris—Nord Aviation and the Hawker-Siddeley Group intend to exploit jointly the Mach 2 target missile, the CT-4B, recently developed by the French manufacturer. The CT-4B is powered by two boosters mounted on the wings of the target missile.

Under the Franco-British agreement, Hawker will undertake to build and supply the missile and partners will handle sales efforts throughout the British Commonwealth. Nord's earlier target missile, the CT-2B, achieved considerable success with NATO.



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Eclipse-Pioneer know-how under the Wingspan System concept dates from the very first customer of this type—on our association with Convair on the Air Force B-52 Hustler. Here, we developed and now manufacture the Air Force's first Automatic Flight Control System, Stability Augmentation and Central Air Data System. Aspects of our major sub-system responsibilities go to the Martin Company for initial

Guidance, Stable Platform and associated equipment on the Army's Pending missile.

With our physical resources—2,000 engineers, 800 other highly skilled workers, 1,384,000 square feet of plant space, plus the most modern tools and equipment—and you have the significant total reason why Eclipse-Pioneer is your best choice as a knowledgeable partner for prime contractors on advanced aircraft and missile development and production.

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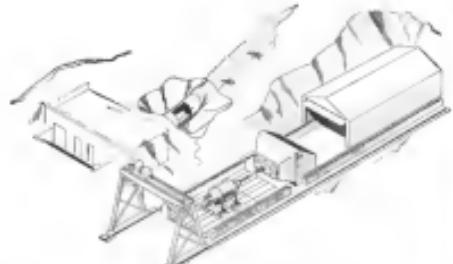


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POLARIS test stand at Naval Ordnance Test Station, China Lake, Calif., has metal housing (right) which rolls back over motor and instruments. Instrumentation cables feed into building at left, through raised up lift to data reduction and control center.

Facility Tests Solid Propellants

China Lake, Calif.—New metal housing test complex capable of handling cagons of up to 1-metric-ton solid propellants has been completed at Naval Ordnance Test Station here.

Aimed primarily at solid propellant cagons, the facility adds to existing test areas which are capable of handling more than 100,000 pounds. Installation cost \$100,000 and it results for E-P now and will start a full scale Polaris four-burner missile engine test program late this year.

Data acquisition, recording and associated equipment is such that the complex will be able to analyze propellant characteristics to within 0.25% error, as compared with the previous standard of 1%.

Design is such that the stand will accommodate normal running thrusters of 1 million lb., while peak thrusts of up to 15 million lb. will be handled. Thruster bay area will be shared by Project 8000, now being developed by Special Projects Office, Naval Research Laboratory.

Test bay is 37 ft. long, 10 ft. wide and can accommodate cagons larger than 6 ft. in diameter, 30 ft. long and weighing up to 100,000 lb. E-P's test and instrumentation blockhouse is located a quarter mile away, buried in a hillside, 37 ft. higher than the test stand.

Engines are first to be brought to a conditioning building where atmospheric conditions of temperature, pressure, humidity are made as similar to match the expected environment of Polaris.

Structure also serves as a storage magazine and can maintain constant temperatures within plus or minus 30° in the range from 70° to 110° F all year. Engines are pushed up against

instrumentation which is buried in 12 in. of steel armor plate mounted on a concrete block 11 ft. thick and 15 ft. high.

Metal shed on rails rolls over the cagons during run preparation and is rolled away just before firing.

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and
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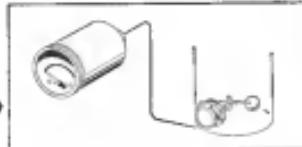
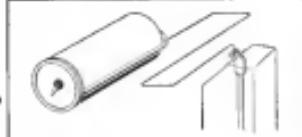
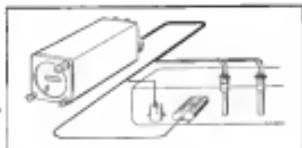


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MANAGEMENT

Data Systems May Supplement Weapons

By William H. Gregory

Boston-Singer companies are beginning to orient themselves toward defense business in the 1950s, on the premise that a new kind of system built around the gathering and processing of intelligence will be a major factor in maintaining national security.

Int. Corp. is one. Another is Thompson Ramo Wooldridge, which has just opened an Information Laboratory specializing in data processing fields. Computer work already is heavily or generally involved in the data process and, as IBM, General Electric and others—could also be expected to play major roles if such a trend develops.

General Electric Co. has most recently established an Information Systems Section within its Defense Systems Department to design and develop complex management systems involving computer, display and data storage and retrieval equipment as well as in

integrated management techniques. Dr. Lincoln E. Salter of General Electric's Computer Department was named manager.

Certain of the Louis' communication system which USAF is developing may be initial efforts in this area. The 4600-weather system with Bendix Aviation Corp. as prime contractor, for example, offers an indication of how such a system might be constructed (AVW Dec. 6, 1958, p. 80).

Observation Factor

Observation may be a key factor in such a project. With President Roosevelt's Joint Committee for Dismantlement Study headed by Charles A. Coolidge, tests his committee will be on the right side of the curve if dismantlement does come. The committee's report is due by year end.

If dismantlement does come, Liquidometer

will, it will not mean the end of defense systems but rather the transition to a new kind of system. The transition will be a long slow one, he believes, and in the beginning would be more costly than current weapon systems. A system such as Lighorn but in road might comprise these elements:

- Space systems on the order of the Soviet satellite communication system now under development
- Aerial inspection, how much depending on the degree of U.S. Soviet agreement
- Ground control inspection, perhaps at the field inspection point, etc.
- Peripheral inspection, through use of long range radar as on the EMEWS system, or searching and possible other types. The FTS-17 radar in Turkey and the Alouette is another example of current types in use.

• Data processing systems not only to handle information from the previous sources but also to search open theaters



Sikorsky S-60 Crane Airlifts S-58

One of 46 Sikorsky S-60 Army helicopters is shown being added by Sikorsky's S-60 flying crane during a shift of aircraft and repair facilities. The S-60s, which weigh four tons each, were used for miles from the Stratford, Conn., Municipal Airport to Sikorsky's plant in Bridgeport. Job was completed in several flying hours. City of Bridgeport is in background.



Maxim JEM-8 Silencer on static test July 1964.

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Drawn here in use at a naval air station, the JEM-8 will shortly be on duty at many other Naval and Marine Corps air stations. A commercial jet version, the JEC-8, is available for pod-hung engines.

For noise suppression, consult Maxim — for it is here that Silence Is A Science.

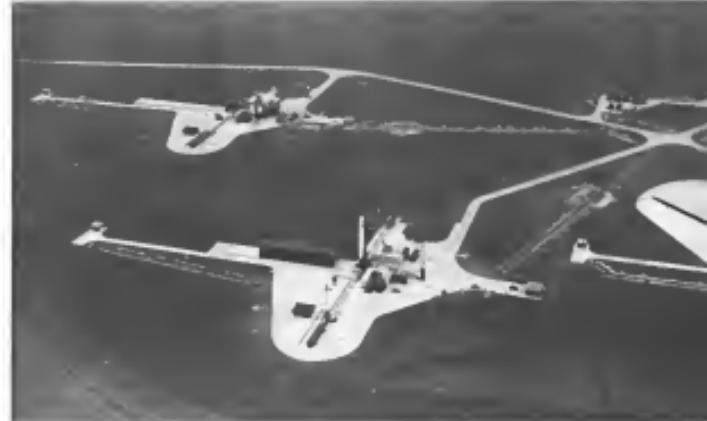


JEM-8 with afterburners cased for test, static.

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British Thor IRBM Site at Feltwell

One of four Thor intermediate range ballistic missile sites now operational in the British Isles (IAW July 14, p. 20) is shown in the Feltwell complex. Nation eventually will have 20 sites. Each of the operational units has three missiles and three pads.

col literature for technical intelligence. Peace is not a scientist. Lighter, he fears, and that's what takes a more sophisticated approach. The dominant theme, though, is a return to the basically unchanged, the orbital not for the necessarily expensive components, would be high, of least initially. But as time goes on, he foresees possible to reduce research costs as the intelligence requires become more efficient, more delicate, spreading world thus be required only to exact precisely known threats and not an array of uncapable of which only a few might actually be threatened for use.

Thus defense systems would be designed to introduce arms stability, not strategic threat. The highly complex intelligence systems would have three broad tasks:

- Warning of operational systems, that is, to provide exact data on what types of weapon systems are in being in other nations. This would include surveillance of such things as missile launch sites and aircraft movements to give warning of intentions.

- Providing data on numbers ranging from force levels to production levels.

- Providing technological development information.

Balance of Power

With reliable data from all these levels—which implies the agreement of all parties other to allow it to be obtained freely as to defend, it'll then become theoretically possible to match one's own forces precisely to the enemy's capabilities and gain a net-positive balance of power.

A certain amount of good faith among the parties seems necessary, though

having the system on a high, unplanned intelligence set uses this with some human intervention. In depth, though, there's a point where it's really, really bad, the orbital not for the necessarily expensive components would be high, of least initially. But as time goes on, he foresees possible to reduce research costs as the intelligence requires become more efficient, more delicate, spreading world thus be required only to exact precisely known threats and not an array of uncapable of which only a few might actually be threatened for use.

The Thorpiana Wasbridge review was issued by Dr. Steven Rubin, executive vice president, at the Federation of the American Sciences, Washington, which was headed by Dr. James M. Salter.

In the 1960s, the U.S. military's primary needs will be in the intermediate field. Just as greater bombs have given way to nuclear weapons and our concern with ICBMs has changed to a concern about intercontinental ballistic missiles, so the future will involve a different and a better battle for supremacy in self-electronics.

We have already seen the emergence of the hostile camps of an aggressive array of firms to make possible a final destruction of the other and will soon recognize the matched capability for

deferring this form. Control of the intelligence and the various systems involved the delivery of force is now rising to a new point.

The Thorpiana Wasbridge laboratory will not be confined to developing such systems, but will work on various approaches to data processing, no machine translation of languages and to systems for airborne navigation and strategic control.

Itch's Plan

His plan aims to fit itself into what it foresees as the market of the 1980s provide an example of industry taking an adaptation to a rapidly changing technology—and some of the problems.

Global market companies which consider 90-10 as a real military-cum-civil breakdown in business, Itch uses a 70-30, but says this can't extend further than simply diversification.

• **Military business**, now running about one-third of Itch's total earnings, would remain at that level steadily. Latham estimates the future military information retrieval market at \$1 billion, and is aiming at a 5-10% share of that market for Itch.

• **Commercial business** is sought as the primary source of funds to mount on a research-based company. Under this situation the company then would be able

WANTED: 4 MEN FOR KEY POSTS IN ASTRIONICS

If ever an organization was designed from the start for space system development and production, the one is.

Formed last August, *Chance Vought's Astronics Division* already has made first delivery on a NASA contract to provide space research vehicles.

For the future, four major lines of interest have been chosen: development of space research-type research vehicles, research payloads, including telecommunications and environmental infrared, man-rated space vehicles, and long-range studies to anticipate future needs.

This is a self-sufficient, self-sustaining division. A few key posts are being filled now with men who can both mold the organization and move its space programs. Four such men are needed to fill these various positions:

1. Senior Specialist for Navigation and Guidance Group. Advanced E.E., Ph.D. preferred. Experience in stellar navigation and star tracking system techniques and in RF guidance and inertial navigation systems. To manage the use of chemical, acoustical, handle conceptual design.

to control its own destiny, its president believes.

Earlier in the development of the company, Leggett had estimated the company would need a minimum annual sales volume of \$50 million at the 70-50 business-commercial ratio to give a self-sustaining character as a research based company. Leggett's actual sales in 1969 for \$500 million sales volume so bring the company into existence.

It has initially financed two years

ago by

Leggett

and his

associates,

a step which marked the

beginning

of the

company.

Today

the

company

is

now

in

the

process

of

expanding

its

operations

and

expanding

its

size

and

size



Morines Order Lockheed GV-1 Hercules

U. S. Marine Corps version of the Lockheed Air Force C-130 Hercules, designated GV-1, will be built under a \$19,200,000 Navy contract at Lockheed Aircraft's Marietta, Ga., plant. Preprints are four Allis T35 turboprops. Range is 4,300 mi.; au-

thorized forward endurance is 10 hr.; max. speed is 300 mph. The aircraft will be used to move Marine Corps equipment and supplies, to move the company's status with the military as a "subable contractor." However, it brought with it Vertec's contacts with Hughes Aircraft Co. for electronic subsystems for the Palomar satellite.

This year Irak acquired Photonic Corp. of Rochester, N. Y., which it wants to be an important source of commercial business. It also acquired an 85% interest in Vixar, Inc., a company started by former National Aeronautics and Space Administration employees at Palo Alto, Calif., at an entry into the space field. Vixar now is studying a new type of plasma applica-



Army to Test HU-1A Attack Capability

Development of Bell UH-1A helicopter's attack capabilities to include use in fire suppression on the battlefield will be tested by U. S. Army's Rocket and Guided Missile Agency at Redstone Arsenal and the Army Aviation Center at Ft. Rucker. Bell has fitted an HU-1A, in white with a camouflage mask extending from each side of the helicopter, permitting carriage of an Army Nuclear Naval 5313 solid propellant, remote-controlled rocket weapon. The SEM-1B 5313 would be controlled to the target by the remote control over its effective range of more than 3,300 yds. Installation was performed in the co-pilot's cabin under an Army contract.

An equally recent Rockefeller investment, Comptech Corp. of America, which studies Irak's alternative as well as his no other connection, represents a much greater distance on the road to selling out research. So does General Applied Science Laboratories, Inc., a Long Island, N. Y., group in which Dr. Theodore von Karman and Dr. Arthur Farni of Brookhaven National Laboratory are interested. This Rockwood-federated group plans to stick with research to research as a business.

Systems Approach

Irak is organized around the systems approach in the present field, which is information retrieval. (The word "link" is coined from the words information technology.) In systems like its Irak, it will be using computers, but when suitable applications will be set up in its own electronics capability to develop the approach that doesn't exist.

Photonic products will be oriented more toward hardware. It now deals in various papers and chemicals and concentrated development will call for production of specialized equipment.

In optics and photography, the company does grant lenses and develop other hardware, but the operation is strongly directed toward research though not research the role of it.

This organization tends resolution

qualifiers of film for microfilmers. But a more typical example of what Irak means by "systems-based" company is the company approach that the top people are doing no photography at all.

Temperature-extreme heat or cold—do not seem to present as severe a potential problem as doisms or a vacuum which might cause the film to crack or radiation which might streak the film. One approach being investigated is a so-called, ammonia salt condition which would not be sensitive to radiation.

No specific application is isolated now, but the possibilities for military or commercial use are evident.

Information retrieval is a field Irak has been getting competitive, however, which he might have at a young company out to market with Western Reserve University, one of the partners in Western America's Center for Data Retrieval and Computation. Research has been done as projects in various technical areas, one of the more prominent as metallurgy in cooperation with the American Society for Metals.

Western Reserve sponsored a conference last summer which included participation by Russians from the Soviet Academy of Sciences which is taking a strong interest in the problems of accurately abstracting and indexing for quick reading to audience the 10,000 scientific journals, 60,000 books and 100,000 reports being published annually.

Both Irak and Western Reserve staffs of establishments of telecommunications centers at key cities where responses for information storage and searching could be automated. Both are involved in the development of systems for precise methods of coding information so that it can be stored in present types of equipment.

"It was a National Science Foundation grant to Irak in the latter area that led Allen Kent, associate director of the Western Reserve center, to make designs of digitizers before the Senate Subcommittee on Telecommunications and Information Policy in spring. The committee was looking for a grant on a bill to establish a U. S. Department of Science.

The Irak program is an attempt to develop a language, called L-representation, that can be automatically understood. This goes the terms from functional calculus to decide things into functions, which include properties of and relatives among things, and arguments, which are close things having properties and things related.

Thus the subject "inhibition of publication with disruptor device" representation would be a function and publication and disruptor device each as arguments. By assigning symbols to

each one, not only can the specific human be interested and stored, but a code handling pattern can also be developed. Thus it becomes possible to characterize associated information that might be produced by the source in his systems called records.

National Science Foundation developed its grant by pointing out that the proposal won second in 17 radio contests with experience in the field, but the reality between the two organizations still exists.

Search Selector

Irak is using a search selector made by Computer Control Co., Whitefish, Mont. Werner Renn, a spokesman with General Electric in the development of the GE 250 selector in its program.

One of Irak's principal problems is the rapid growth it has attained and the organization's structure has given this to Leghorn said in a meeting of the

Boston Society of Security Analysts on the subject of the stock price rise. "Let me say that we have been surprised, disturbed, proud and concerned."

By decreasing Leghorn's future oil sales and profit goals as being already attained in fast, inevitable, hard, in effect, found a certain amount of pressure on the company to keep on growing quickly.

This is an added strain on the ones still continuing what a company's future is increasing—open. When a management accustomed to operating in a growth environment suddenly is forced to deal with more people, more money and more complex problems.

Thus Leghorn has told investors of the potential for the company because of its participation in new areas of technology, and its commercial diversification, but he also has warned them to take a careful look at Irak, because some of the usual rules of thumb apply to the company at its present stage.



Indianapolis Computer Links Control Centers

Computer of Indianapolis, Ind., An Route Traffic Control Center (short) has been fully implemented at Washington, D. C., Cleveland, Ohio, and Pittsburgh, Pa. Systems is interconnected between Midwest Express 650 and in fact to automatically exchange information with other Federal Aviation Agency centers equipped with computers. At left is Indianapolis main control room for traffic controllers, seated at the Bureau 510 computer PDP 10's plane to test electronic computers in about 30 other centers.



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Allied Research, working in another dimension, directs its efforts into basic research, applying new concepts to the field of meteorology, nuclear weapons effects, physics, chemistry, weapons systems analysis, propulsion and other advanced areas.

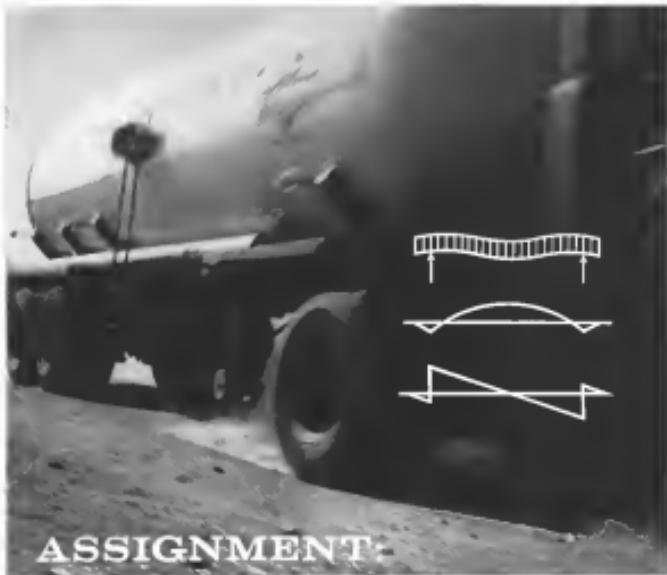
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SUPersonic model with camber is tested in the Langley 4 x 5 ft. supersonic wind tunnel. New NASA supersonic transport design concept eliminates need for a camber and uses a highly swept wing in place of the delta wing shown on this model.

NASA Studies Supersonic Transports

By Craig Lewin

Langley Field, Va.—New supersonic design concept has been developed by the National Aeronautics and Space Administration that puts an advanced supersonic entry into the field of design generally discussed for supersonic transports.

While similar to the transonic aircraft design tested here at Langley Research Center the supersonic layout is considerably more complex. It denotes both the camber and horizontal tail surfaces and has a thin, carefully shaped fuselage and a highly swept wing with engines podded in the wing afterbodies.

A recent development, this supersonic aircraft concept offers higher lift/drag ratios than those for the delta wing of the type used on the North American B-70 Mach 3 bomber, a wing similar to the design's most supersonic transport payloads. The B-70 wing design was laid down three to four years ago at a time when the new NASA concept did not exist.

The basic NASA contribution to supersonic design may be among its best in view of the sharply diminishing return in unclassified research. With



NASA supersonic transport design concept involves special combination of wing design and fuselage shape. Fuselage shape is canted in the rear, and the sweep effect goes from the front of the fuselage to the forward part of the wing near the leading edge to 60°. The main wing planform is designed to keep 50° over the forward section of the wing where surface is most favorable. NASA maintains estimate that design has about half the drag due to lift of the supersonic delta wing such as the one used on the B-70.



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THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC.

Columbus, Ohio



space program, sheathing the bulk of NASA funds and energy, and with the declining aviation interest in non-high speed aircraft, aeronautical research is limited to minor status in the agency which was once completely dominated (AW Nov. 30, p. 26).

Exception to this trend is a VTOL research, which will continue as a sub-divisional program. Prospects of a hypersonic transport could be among the most promising candidates of the trend. If analysis had to pay for and conduct all of the basic research necessary to develop a hypersonic transport, economic considerations might kill it even before its feasibility is established.

Although it is visually similar to the transonic and subsonic, the new NASA supersonic concept produces a design that is "far" outside new approaches, a further extension of sonic speed, according to Richard Whitcomb, NASA aeronautical research manager and author of the 1954 Collier Trophy paper for developing the transonic area rule.

Whitcomb told Aviation Week that the supersonic concept realized the point where it appeared feasible a year ago, and that it has evolved into an efficient design within the past six months.

NASA supersonic transport is still a research model, but it has moved into fairly detailed design. Whitcomb said several aircraft manufacturers are studying it, but he also cautioned that it is a complicated design and must demonstrate distinct advantages to supersede the various designs proposed in earlier supersonic transport planning.

In its present form, the NASA supersonic design is for a Mach 2.2 transport. An aircraft in this speed range can be constructed of fairly conventional aluminum materials, while a Mach 3 transport will have heating problems severe enough to make the titanium alloy questionable. The debate over whether to build a Mach 2.2 transport or jump all the way to Mach 3 is a prime argument in the industry, and apparently only Lockheed Aircraft Corp. is committed to the Mach 3 approach at this time.

The question is crucial, since the switch for a supersonic transport is "butifully" 100 or 150 in aeronautical and market realities prohibit even the relatively limited number of entries now bidding for subsonic transoceanic transport orders.

Wing on the Mach 2.2 model is swept 70 deg. at the leading edge. Sweep can be increased by increasing the wing sweep, and a Mach 3 version would have about a 75 deg. sweep. In terms of the wing design is indicated by its slightly S-shaped spanwise profile, with an upward curve toward the



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glass, medical, and marine with Surface and Kathabar equipment...residential, commercial and industrial building with nationally advertised "Janitrol" oil- and gas-fired furnaces, unit heaters, and air-conditioning equipment...aircraft and missile with Janitrol Aircraft products.

Assets of the enlarged Midland-Ross organization are now over \$70,000,000. Employees now total 5,800. Fourteen plants are located in six states and Canada. Sales in 1960 are forecast at more than \$120,000,000.

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CASE HISTORIES



From New Departure's R&D Laboratories, come bearing designs that are the result of extensive research and development work. The photo shows one of the many precision ball bearings used in the X-15.

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In the heart of this piloted space probe, a volatile mixture of liquid fuel is chambered at 20,000 pounds per minute into rocket thrust, through a unique throttle of the main fuel system. Within this cryogenic system, New Departure corrosion resistant ball bearings hold their prosperity to within the most exacting specifications... giving support to a pair of the reaction system's valves, assuring virtually torqueless, millisecond response.

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flapage and a downward curve toward the wing tip. Engines are poised in an wing aerofoils and the air being behind the wing structure for safety reasons. Brake ducts for the powerplant come through the main wing structure.

The highly swept wing design is unique in that the shock wave is deflected further aft than the leading edge, and smoothing air flow. The leading edge is swept behind the shock, wave generated by the fuselage, and the wing flies in an airflow considerably slower than that at front of the shock wave.

Since the airflow is favorable for lift over the forward part of this wing design, the purpose is to let it forward. Wing aerofoils are used to slow the airflow over the rear portion of the wing and keep the main lift for wing. For the same reason, the large aft wing area characteristic of the delta wing is eliminated because it is inefficient. Whitcomb estimates the NASA swept wing has drag due to lift about half that of the B-70 type delta wing.

Fuselage shape also plays a key role in the wing lift characteristics. Whitcomb told Aviation Week the swept wing is not superior to the delta wing by itself, but that it is superior when coupled with the fuselage and the wing aerofoils and the fuselage. The fuselage has a flat, sharp front with tapering to the point where the leading edge is a point; then it is rounded over the wing root and tapers to its greatest thickness near the wing trailing edge.

Canard Fuselage

In contrast, the generic fuselage cross-section with the fuselage root to near the leading edge.

The fuselage, more so than the wing is a rated factor in the supersonic design. Reducing the leading off of the leading edge and generates low pressure over the large forward area of the wing rear the fuselage. The fuselage is the main load to produce lift forward and balance the aircraft. This eliminates the need for a center.

Whitcomb originally wanted to carry passengers in the middle rear area of the fuselage, but found that it would be better in the forward section for balance. He also found that the nose section must be made longer and fatter to accommodate more people in order to make the aircraft a practical operational transport.

Horizontal tail surfaces have been eliminated along with the canard. The wing is swept enough so that the tips are near the tail area, and elevons can replace the horizontal tail surfaces, fitting with a vertical tail surface for directional control. The whole outboard wing panel serves as an elevon for profiling around a supersonic inlet at about the

one third chord point. Mechanics for the elevon are housed in a pod which forms the outboard wing aerofoil.

A Mach 2.2 transport using the NASA concept would be in the same 100,000-lb gross weight class as present transonic and subsonic transports. Whitcomb estimates that it would be an aircraft that would have about the same range as present jets, but one which would be much faster. This makes it a transonic and transonic/cruise ship transport. Greater speed will require more power, which NASA develops some means of shortening aircraft life for its supersonic design.

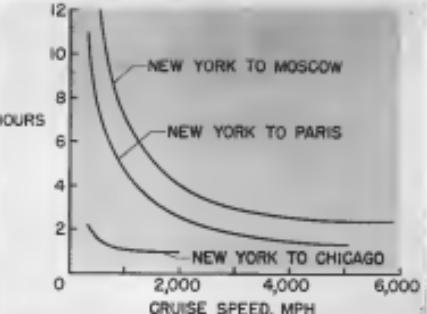
During the recent biannual inspection, NASA researchers expressed confidence that, despite difficulties of rocket-powered transports, most air transports will take place in aircraft that will cruise in the stratosphere powered by subsonic engines. NASA said it is continuing to emphasize research to advance performance characteristics of such aircraft.

Fuselage shape also plays a key role in the wing lift characteristics. Whitcomb told Aviation Week the swept wing is not superior to the delta wing by itself, but that it is superior when coupled with the fuselage and the wing aerofoils and the fuselage. The fuselage has a flat, sharp front with tapering to the point where the leading edge is a point; then it is rounded over the wing root and tapers to its greatest thickness near the wing trailing edge.

By the time it is long as New York-Moscow, the supersonic transport will have to be twice as strong as the transonic airplane, which means it is an aircraft that would have about the same range as present jets, but one which would be much faster. This makes it a transonic and transonic/cruise ship transport. Greater speed will require more power, which NASA develops some means of shortening aircraft life for its supersonic design.

From its research, NASA has concluded that supersonic transports with flight efficiencies comparable to subsonic turbine transports appear to be technically feasible. Researchers said there are technical problems other than flight efficiency to be considered but that none of them appears insurmountable. This also pointed out that the "essence of expansion" will play a large part in determining whether a supersonic transport ever gets into service.

Discussing its approaches to various design problems with successor transports, NASA said one way can be increased by using long, thin wings and fuselage or by sweeping the wings back at a large angle. Redesigning subcritical reduction resulting from attempting to cut drag due to MR, NASA cited its new supersonic transport concept and the technique of flattening the



NASA chart shows how flight time decreases as cruise speed increases over three typical routes. Curve show that at 3000 mph is just at speeds higher than 700 mph, between Chicago and New York and that these times are as well on the New York-Moscow route, but the times are far greater than those between subsonic and supersonic transports.



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top of the fuselage to produce lift more efficiently and help the wing in its approach to the ground. The flat-cord bracing approach has been adopted to the A-70.

Friction drag is another problem, and NASA warned of the need for extremely smooth surfaces on successive mannequins to maintain that status. Whitcomb told AVIATION WEEK several manufacturers are developing techniques for smoothing aircraft surfaces, and he pointed to the Convair 880 as an example of progress in this area. He observed that any inexpensive airplane won't be smooth if it is to have

Hypersonic Research

Work on hypersonic transport research is in a considerably less advanced state than the supersonic work. NASA has reached the point of testing simple models in wind tunnels, but the technical feasibility of such aircraft has not yet been established. NASA will study drag characteristics of various configurations, as well as problems of stability and control of complete vehicles.

Heating will be a severe problem with a hypersonic transport, and NASA researchers point out that temperatures in the ramjet engines will be higher than those encountered in the aircraft itself. At Mach 6, they estimate the temperature in the combustion chamber at about 4,000°. Since these temperatures are beyond the capabilities of stainless steel, the engine will have to be made from a relatively new material, probably with ceramic coatings in the combustion chamber, heat and cool sections.

Even with exotic materials, NASA thinks a cooling system will be necessary.

One scheme involves perforating the engine cooling to allow the hot outer surface to radiate heat directly to free space. Above Mach 6, NASA feels a mechanical cooling system will be needed for the engine and possibly the inlets.

Fuel can be circulated through hot areas to cool them, but the area temperature will break down at the time temperatures expected so that another fuel would have to be used. Hydrogen would be good for cooling and as an energy source, but the aircraft would have to have a very large and bulky tankage to carry enough of the very lightweight gas.

NASA has done considerable research in transonic transport design, but this work is almost finished. Whitcomb points out that researchers have reached the ultimate shape from the aerodynamic point of view. Some use of the transonic area rule concept has been made with the wing aerofoils on the Convair 880, but there appears to be



A-3J Utilizes High-Strength Steel Landing Gear

Mac landing gear of the North American A-3J Navy attack aircraft utilizes Stress high strength steel alloy. Stress, developed by Al-S Steel Corp., is used for the outer cylinder, inner cylinder, fork and a torsion bar. The nose gear utilizes the material on its piston and strut. The Boulton landing gear is operated pneumatically by compressed nitrogen.

It is felt that other designs will be produced using the complete concept with as shaped landing gear and with nitrogen padded in wing aerofoils.

NASA estimates that their new rule features could increase cruise speed of current transonic transports about 100 mph, constituting only cruise efficiency. Such other factors as extra weight and fuel would have to be considered before overall performance gains and economic advantages could be assessed.

Admiralty Evaluates British Hovercraft

London—Stansted-Race Hovercraft air cushion vehicles (AV Sep. 14, p. 30) has undergone a three-day evaluation by British Admiralty scientists to assess operational potential of the vehicles.

Plans to develop the Hovercraft commercially were announced by the sponsor, the National Research Development Corp., but financial backing for the project still has to be negotiated, Deputy Director Dennis Henshaw told AVIATION WEEK. Discussions are proceeding with a number of industrial firms.

Immediate development of the craft is likely to be in the form of relatively small units not exceeding 100 tons which would be suitable for operating in undeveloped regions.

Designs have been completed. Henshaw said the vehicles should be available commercially by 1963.

Inventor of the Hovercraft, Christopher Cockerell, said he recently that the American design currently being tested is "far more primitive, but capable of lifting one man, but certainly not capable of going from A to B."



Airlift in action:

Building a base on Arctic ice



Reverse thrust of jet powered propellers breaks "Ski 130" transports to short, safe stops. Giant gax, fitted over landing wheels, retract to permit landings on or takeoffs from surfaced runways.

Heavy steel structures, pre-fabricated in 40 foot sections, were part of DEW Line cargo airtight from Sondrestrom AFB, Greenland by 61st T.O. Sq. of the Tactical Air Command's 9th Air Force.



Flying through 40-below storms and fog, Lockheed-built C-130 HERCULES transports of the U. S. Air Force ski-landed 26 million pounds of cargo on Greenland's ice cap. Tractors, trucks, machinery, tools, pre-fabricated radar towers and buildings, lumber, cement, crates by the hundred—plus the personnel needed to build two vital new DEW Line bases. Mission accomplished (ahead of schedule), the "Ski-130" planes headed for Antarctica to support a U. S. Navy expedition.

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Model, with 32 ft wingspan and two J69 engines is used in jet flap research at NASA Langley Research Center. Test will be conducted with both half span and full span flaps.

NASA Begins Advanced Jet Flap Tests

Langley Field, Va.—Jet flap research is moving into a new, large, logic scale test stage here which will provide more realistic simulation of conditions met by a turbojet transport which might use the STOL technique.

National Aeronautics and Space Administration is starting jet flap tests in its full-scale wind tunnel here at Langley Research Center with a 32 ft wingspan model equipped with two Continental J69 engines. Use of the large, sweptwing model and the hot exhaust stream of the J69 will provide a more realistic test than the research with smaller models and cold compressed air NASA has conducted here for several years (AW Oct. 27, p. 54). These linear tests are being con-

ducted with the external flow type jet flap technique which uses engine exhaust deflected up over the wing flap to produce added lift and decrease takeoff and landing roll. NASA has also explored the technique of installing several small turbojet engines in the wing to exhaust from the wing trailing edge over the flap to increase lift.

Subsonic Use

The external flow type of jet flap technique could be most readily applied to such current subsonic aircraft as the conventional Boeing 707 and Douglas DC-8 and the smaller KC-135 and B-57. The new test series will provide more realistic data for possible application to these aircraft, although

it appears that the technique has been developed too late for use in the current group of large, subsonic aircraft.

Model now in the full-scale tunnel has the same general wing design and flap configuration as the smaller models previously used. Tests will be conducted with both half span and full span flaps, and researchers will study different gaps and distances between wing and flap to find the optimum wing-flap relationship. Later tests may investigate roll use and position.

The two J69 engines, nominally rated at about 800 lb thrust, are podded under the wings and braced so they can be pivoted upward to direct the exhaust flow against the bottom of the wing, through the flap gap and over the



WING surfaces of the J69 engines (left) have faced 100% water cooled panels to protect them from heat generated by heating tests of jet flap techniques. Engines are tilted to direct exhaust stream up over the wing flaps. Hot exhaust nozzle (right) is forced by piping around small exhaust tubes.





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Sabrejet Used as Orpheus 12 Testbed

North American Sabrejet is being used as a flying testbed for British Boulton Orpheus 12 turbjet engine (AW Sept. 18, p. 37). Engine, which produces 8,178 lb. thrust with afterburner, was developed as a second generation strike fighter powerplant.

Top of the flap. In actual use, the exhaust nozzle itself could be klaged to direct the exhaust flow upward from a fixed engine.

Bottom wing surfaces of the model have water-cooled Inconel-X panels in the area behind the hot engine exhaust. These are to protect the wing from heat during runs which might run as long as one hour, and the exhaust stream would be deflected upward for only one or two minutes during landing and takeoff, and heat protection would not have to be as extensive as that provided for the nozzle.

NASA has lubricated flat, fluid nozzles for the J36s to spread the exhaust flow and direct it over the flap. Several small tubes leading from the engine exhaust are flattened and joined to form the nozzle. This is less efficient than a single nozzle, but avoids problems involved in using large areas of sheet metal under high temperature.

In experimental aircraft, nozzle design would be a key factor in a jet augmented flap system. The aim is to get the exhaust flow through the wing-flap gap over the flap and spread out as wide a span of the flap as possible. The high velocity air can provide lift and downward acceleration over the flap ahead of the flap. This calls for flat nozzle shapes to flatten and spread the jet exhaust sheet.

Control nozzles are designed only to shape the airflow for flap purposes, but operational design would have to consider cruise flight efficiency and then be carefully tailored to the intended engine method. Nozzles would have to be designed for low drag losses to keep the loss in cruise efficiency low. Even with an efficient nozzle using the jet flap technique will mean trading some cruise efficiency for the STOL capability gained.

the jet flap technique, high circulation induces downwash, and increased lift-induced drag would probably be required to maintain controllability.

Tests indicated that an aircraft could be transitioned with an horizontal tail up to about C.12, and past that point would need a vertical tailplane, which might be a better approach, but it has sonic stability problems not present with a horizontal tail, and the aircraft still would then require a jet augmented flap. Directional stability is not considered a problem.

The external flow jet flap system could be retrofitted to current transport and hauler designs to produce the dramatic STOL capability calculated for it, but a number of factors involved in installing and operating it must be balanced before a final economic and technical evaluation can be made. Loss in cruise efficiency from the flat nozzle is one factor, and the weight added by the nozzle and other hardware is another. Long term problems of heat and acoustic fatigue on the bottom wing and flap surfaces would probably require some structural scaling and new materials.

None is a further consideration, since the exhaust stream is blown over the bottom surface of the wing and it would be more under the wing than on the top surface, which is a greater problem. This probably wouldn't be a serious problem, however, since the jet flap would be used only for short periods after takeoff and before landing, and most of this time would be spent inside airport boundaries.



Piasocki Platform Starts Yaw, Speed Tests

Assigned and yet untested probe has been fitted in the Piasocki YZ-12 flying platform in another phase of Army research program. Platform now uses a Tinhornet Autotest III aircraft (AW July 13, p. 128), highest altitude to be in 20 ft.

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bio-sensors for the ground segment equipment on the 1.1F Midori program. Measures AC and DC single ended voltages and AC and DC sum DC differential voltages are performed. Counter for 4 resulted reading channel including other certain measurements.

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BUSINESS FLYING



PRODUCTION line at Beech Aircraft Corp.'s Plant No. 2 at Wichita emphasizes the sharp upturn in business flying.

Beech Aims at \$60 Million Sales Year

By Erwin J. Bellan

WICHITA, KAN.—Calling 1960 "a year of decisions" during which Beech Aircraft Corp. will be the forerunner that will determine its future in the postwar but competitively tough decade ahead, Vice President Commandant Sam Ladd, Givens set a goal of more than \$45 million in factory billings for 1960 aircraft and parts before some 370 distributor and dealer representatives attending the company's annual sales meeting here.

Achievement of this revised goal will mean that, at consumer list prices, anticipated businessmen will spend a total of some \$60 million for new Beech aircraft and equipment in 1960—more than double what they purchased from the entire industry a decade before.

In spite of the heaviest hitting sales talk he has yet delivered, Givens said there is no sign that these will be an

outbreak, but pointed out that there are other people in this business and nothing will come easy. To meet the goal of "\$60 million in '60" is going to take an increased sense of responsibility on the part of the entire sales organization and greater enthusiasm to sell all of these new aircraft, he said.

He emphasized the "all" by indicating that there still are too many people who have their "frontline" airplanes on which they spend the major portion of their sales effort to the detriment of other models. And he also emphasized that to increase sales will mean that there will have to be "more of variety, more selection and more dollars."

Givens' optimism that Beech would meet the goal of \$60 million in 1960 seems to rest on solid ground—although in the field aviation it will be the field sales force that will provide the payoff. There are these factors in favor of the company's distributor-dealer organization:

tion that is moving over to a greater extent than ever before.

• Low inventories of 1959 models, which give the dealers a good start in promoting the 1960 models. Bonanza inventories, for example, are less than half of what they were a year ago, Givens noted. Super 75 inventories are almost gone, he said.

• More than 25% of the company's present record-breaking backlog of more than \$24 million worth of new airplanes ordered by dealers has already been sold to customers right away. Beech this year, with the inventory situation looking favorable, held a meeting last August with top distributors and dealers to brief them in advance of the several sales meetings so they were able to start their sales campaigns early and tap into prospects who might have bought competitive models in the interim.

• Major improvements in its models, in response to dealer requests, should cu-



TRACK-MOUNTED seats on Beech 75A Bonanza (left) are a side feature this year; forward view shows baggage storage area. View of plane's interior door is at right; in use it allows the user to change his wing and rear seats in no time.



LARGER tail on 1960 Beech 75 Travel Air takes care of center of gravity moved forward by lengthening the cabin. Both rear track-mounted and seats can be lowered to provide load. Electrical panel is at left side of cockpit, providing more panel room.



REVISED instrument panel in the Beech M31 is shown at the left; auxiliary fuel switch has been relocated to the center, near the throttle. Square wingtips keynote the M31. Formerly a "t" style, the tips improve aerodynamics.





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16. Mat. Army. Ground-to-air. Prime contractor: General Dynamics.
17. Nike Ajax. Army. Ground-to-ground. Prime contractor: Westinghouse Electric.
18. Sergeant. Army. Ground-to-ground. Prime contractor: Martin.
19. Mat. Army. Ground-to-air. Prime contractor: Boeing.
20. Mat. Army. Ground-to-ground. Prime contractor: Olymplex Corp.



DISCOUNT four-star, priced at \$19,995, will put Beach into a market held by Fisher with the Convoy and Cirrus with the Model 210.

With the sales force to overcome objections that they had lost their sales in the past. New Town Bonanza, for example, this year have an integral air star door providing easy access to the cabin and individual truck mounted charm. The company is holding the 1999 price on several important models, such as the Bonanza and Travel Air, even with the addition of considerable improvements.

+ Lüger needed time at 1960 adds the new conditions from Quebec. And between the Sieger G18 and the Tissot AV, and the four-plane Dehnsaur at the lower-point end of the scale for those who did not feel much, to step up to the Bonnemarie single just yet, making it possible for the organization to step wider and lets them do even better.

But, ladies, spokesman quickly pointed out, these plantations hardly mean that the distributor and dealers only have to order airplanes and sit back expecting them to roll themselves. Competition from Cessna and Piper is going to be larger than ever before (AW Nos. 2, p. 184; Nos. 3, p. 185) with all the new aircraft coming fully equipped, complete with seats and effective model lines. This competition has already made itself felt in the sales charts, as Gruver pointed out, in the decade 1950-1959, the business aircraft manufacturing industry's volume has shot up some 500%, while Beach growth has been 600%.

In discussing the growth in human colonies available to the distributor, Grotter noted that in 1959 the company granted over \$16 million in discounts to domestic outlets, compared with just over \$2 million in 1953 and just over \$5 million in 1955. In the 1949-1959 period, Becht discounts to distributors have increased some 300%, he noted, while the company's total business has increased some 600%. In

1999, discounts to domestic distributors included approximately \$3.1 million on

approximately \$1 million on the Beacons, \$1.5 million on the Travel Air, \$1.5 million on the Twin Beams and approximately \$2.5 million on the Super 18. And on the basis of generally-accepted financial statements, these sales and services earned revenue better than 10% prior after taxes, with a net of better than 22% before taxes, based on gross benefits including sales of airplane, parts, service, fuel and all other income.

Plasmid Self-Replicators

Importance of the distributor dealers' financial statement was underscored by R. A. Bell, who heads up Beck Acceptance Corp., the company's wholly owned financing arm. He told the listeners that their month's financial statement was one of the most important things they had for planning their future, because it spotlights a business' good and bad points.

Holding up his financial statements from Bush derivatives, he noted that only two of five showed that there

auditors were making money in all departments and not as much as they could or should.

A detailed statement may tell the shareholders that he is losing money in his service department—but not who. This takes usual expense control, usually on fixed expenses, which are naturally to manage. He justified our budget personnel should spend 80-85% of funds on personnel, so the distributor and dealers have to keep track of how these people are being used, how they are being managed and how they buy. Good organization is needed to make sure that high-priced professionals are not doing low-pay, or lesser work, like embossing

Marketing Service Manager. Paul Allen pointed out that a lot of money is being lost by sales outlets in the network that handle space parts orders. In fiscal 1959, Beach collected some \$49 million worth of parts to distribute through its expert distribution, yet only 27% made purchases on a regular basis. The rest, which purchases them with an average 15% commission.

Based on the 1995 representation of the housing, Bell noted that his opinion is that the housing market is about at the peak of its eight-year cycle and that interest rates will show a downward trend as long as they are now for a long period.

The point was that in making a sales contact, the Beech representatives should get into the lease and financing aspects of procuring an airplane to fit the customer in his initial discussion. Many companies already are aware of equipment leasing, he noted—about 71% of truck registrations in this country are on a lease basis, and automobile registrations are higher—and customers will be sensitive to down-payments required to finance aircraft equipment.



LARGE side windows and three-piece windshield mark the 1940 Super C18. Side windows incorporate a lower storm panel.



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Lockheed for telemetry

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The Lockheed Electronics and Avionics Division (LEAD) is currently conducting research in Frequency Modulated and Pulse Modulated Systems for industrial and military needs.

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Civil Aircraft, Engine Shipments

Shipments by Plant Manufacturing Complete Civilian Aircraft and Engines for Civilian Aircraft

Item	Units	Units	Rate
	1959	1958	Jan.-Sept.
Complete aircraft, total aircraft weight	(Each 100 lbs.)	1,772	1,16,042
By weight of plane:			
Under 3,000 lb. aircraft weight	do	499	1
3,000 lb. aircraft weight and over	do	1,223	8
Over 3,000 lb. aircraft weight	do	1,249	8
By number of planes:			
1- and 2-place	do	382	1
3- and 5-place	do	1,010	8
Over 5-place	do	1,390	8
By total rated horsepower, all engines:			
Under 100 hp	do	208	2
100-219 hp	do	1,439	7
400 hp. and over	do	1,439	7
Aircraft engines:			
Radial engines	Number	854	7,159
Gas turbines	do	90	50
Complete aircraft	Number	422	6,618
By weight of plane:			
Under 3,000 lb. aircraft weight	do	208	5,497
3,000 lb. aircraft weight and over	do	21	99
By number of planes:			
1- and 2-place	do	282	5,516
3- and 5-place	do	45	474
Over 5-place	do	71	99
By total rated horsepower, all engines:			
Under 100 hp	do	101	2,329
100-219 hp	do	101	2,329
400 hp. and over	do	71	99
Value of shipments of complete aircraft and parts, total	(Each \$100)	52,712	69,679
Aircraft, total	do	71,048	66,735
Under 3,000 lb. aircraft weight	do	7,047	9,238
3,000 lb. aircraft weight and over	do	64,549	57,500
Aircraft parts	do	7,795	6,949
Value of shipments of aircraft engines and parts, total	do	14,890	12,316
Aircraft engines:			
Radial engines	do	3,937	31,449
Gas turbines	do	93	103
Engines parts	do	12,643	100,467
Value of aircraft engines 3,000 lb. aircraft weight and over	Number	215	

D = Withheld to avoid disclosing source for individual companies. Data prepared by Bureau of the Census, Industry Division, Machinery & Equipment, received from 22 companies operating 22 plants producing complete aircraft and aircraft engine companies operating seven plants.

vision type, keep stall speed at 70 mph. Douglas' gross weight increase of 100 lb. useful load is approximately 35 lb. higher. The airplane can take the new Goodrich heat discolor system. Auxiliary fluid tank for propeller is located in nose baggage compartment.

* Debonair Model 33 four-place, which will sell for \$19,995, is designed to compete with the Cessna 170 and Piper Comanche and is in the market area in which Beech sees a volume of some \$55 million over the next two years for its 175 and 180. The Debonair, built by Navionair aircrafts, the company has since found the interior and equipment, put smaller wheels on the airplane and used the 225-hp Continental IO-473A four-supercharged engine to get the price down. With this powerplant and a Hartzell constant-speed, hydrodraulically-controlled propeller, the Debonair has a gross weight of 2,900 lb., useful load of 1,070 lb. and a high speed of 195 mph., with cruise speed being 185 mph. at 75% power at 7,000 ft. and 180 mph. at 65% power at 11,000 ft. Rover engine at 19,800 ft. Final capacity standard tanks, 64 gal., with auxiliary tanks giving 58 gal. usable fuel. Maximum range is 1,770 mi. compared with 845 mi. on standard tanks. Range is at 145 mph. (85% power) at 10,300 ft. Airplane can carry 270 lb. maximum baggage. Type certification was done in safety category.

* Super G-16, slat of the company's new four-place, heavy, twin, has sold well at a base price of \$12,500, or \$3,500 over the 1959 price. Major improvements have been in the cockpit area, a new two-piece windscreen, split at the middle by a center center strip providing considerable visibility to the outside. Extension of overhead canopy provides additional headroom. Radius seats are adjustable 25 in. and a new control lock has been designed that can be engaged into the pilot from a standing position. Large side windows include an openable storm panel, windows can be jettisoned for emergency exit. Instrument panel has been redesigned so that all radio switches are located around the top, the only overhead item being trim switches for Aeropac General JATO system, which can be mounted in the nose of the engine instead of optional equipment. Another feature is the "see through" lights, located along the leading edge of the wings. Oxygen bottles, easily located behind number 5 bellhead in the cabin, now are located in the lower nose on the left side for easier servicing.

Super 18 Sales Manager G. G. Miller noted that 65 sets were sold in 1959 at a total costaver of 1,000 of \$10,6 million. Gino Aviation Co., Virden, took delivery of 11 airplanes, the all-time record since the airplane was introduced. In all, nine distribution outlet

from 1954 to 200% over their quota on the airplane last year.

Miller cautioned distributors not taking on too much workload as regards radio installation on the Sept. 14, pointing out that the factory now has set up a custom radio shop that could free distribution of the need for laying out capital in such facilities, and also obviates the need for holding the airplane up for a month to six weeks after delivery to the distributor prior to handing it over to the customer fully equipped. He noted that one distributor he visited had more \$270,000 worth of radio inventory. Under the new arrangement, the distributor can remain on a factory-sold-out basis in 100% profit and he can get a commission on the labor. Miller explained that installation at the distributor's base "only provides a 2-7% profit."

* Bonanza 333, this year is offered at the same \$25,500 price as last year's 83-1. Beech dropped the letter "E" this year to avoid confusion with USAF-Air. One of the suffixes to denote liaison aircraft. New major changes mark this four-place, which is now in production for '59. Last year during which time 6,161 have been delivered. Separate winglets have been added and instrument markings, placards and decal are matte white for easier readability. Aerobin fuel pump switch has been moved to the center of the instrument panel near the throttle. The company sold 415 E33 Bonanzas last year, 33 more than the previous year in spite of a \$1,000 price increase. Sales Manager G. G. Hensel pointed out, 50% of the company's distribution selling 70% of the total OH sales. Jim Bausum told last year, one was engaged with the extra seat making it a five-place.

Sales Leaders

Heads were paid to the company's distribution and dealers making high sales rates last year. Named for our standing performance on all four models were Carter Carr Flying Service, Allentown, N. M., and Long Air Craft, Omaha, Neb.

Credit for parts shipments for three models were Jack Adams Aircraft Sales, Memphis, Tenn., Almo Aviation, San Antonio, Tex., Atlantic Aviation, New York, Atlantic, Worcester, Mass., Atlantic Aviation, Waukegan, Ill., Atlantic, Dallas, Aerotech, Denver, Colo., Delta, Corpus Christi, Dallas, Colo., Fleet Flying Service, Des Moines, Iowa, Giesen Aviation, Vandalia, Ill., Imperial Aircraft Sales & Service, Kansas City, Mo., and Roane-Terry Aeromarine Corp., Indianapolis, Ind.

Eighteen domestic distribution points the Beach Milles Dolly Club, Miami Aviation, Atlantic Aviation, New York, Atlantic Aviation Service, Philadelphia, Pa., Butler Airplane Sales, Rockford,

Statham

Deep in the heart of many aero-industrial missile is the Statham transducer. Of more than 40,000 parts in a missile, none is more vital than its transducing elements. Without them, it would be difficult if not impossible to determine component reliability or to record the functional performance of the missile in space.

Typical of these rugged liquid-capsule transducers that provide direct connection or commutation to low level voltage-controlled oscillators, this X-Y series, designed for sophisticated instrumentation, is fully described in Data File AW-828-1.

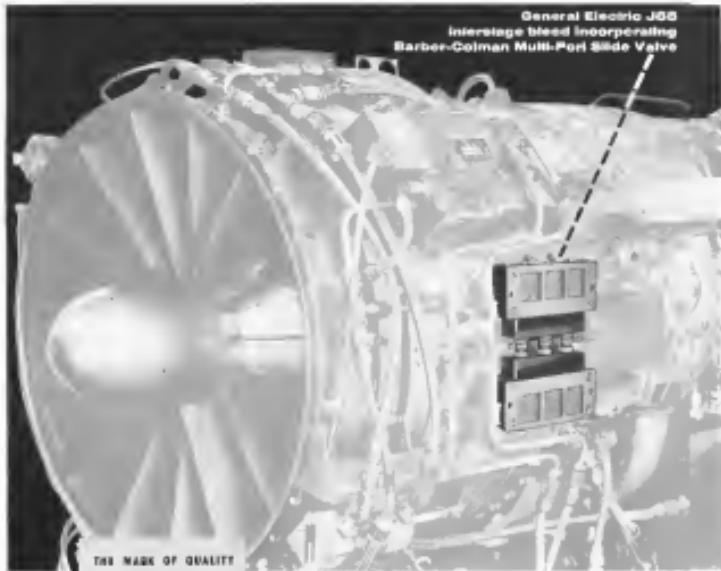
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General Electric J85
Interstage bleed incorporating
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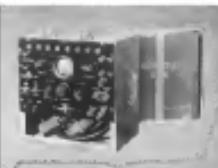
AIR VALVES—A wide variety of electrohydraulic and pneumatically controlled air valves for temperature and pressure control applications. Butterfly, shuttle, poppet, slide, and automatic shut-off types.



ACTUATORS—Rotary and linear types featuring a wide range of gear reduction, switching and mounting details. Available either as standard units or special design to fit various applications. Designed to applicable military specifications.



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TEST EQUIPMENT—Complete electrical test units for quickly checking of components of a Barber-Colman system installed in an aircraft. Special units for checking many electrical systems.

New Barber-Colman Multi-Port Slide Valves developed for General Electric to help give the J85 high performance and efficiency over a wide operating range

In addition to its compact size and light weight, General Electric's new J85 turbojet features high performance and high efficiency over a wide range of operating speeds. Barber-Colman, working with General Electric engineers, developed a unique multi-port slide valve to meet special performance and package requirements. This valve, shown at the left, plays a vital part in the high efficiency of this engine.

Manufactured exclusively by Barber-Colman Company, these valves are made in four-port and six-port types for use in J85 turbojets which will power many of the nation's most advanced piloted aircraft, missiles, and drones. J85 applications include the Northrop T-38 "Talon," and M-156P "Freedom Fighter," the McDonnell GAM-72 decoy missile, and the Raduga Q-68 target drone.

Characteristics of Barber-Colman multi-port slide valves are as follows: Maximum temperature—430°F. Maximum pressure—60 psig at 630°F. Ambient temperature—65°F to 350°F. Total leakage—1.55 lb/yr/in at 60 psig and 630°F.

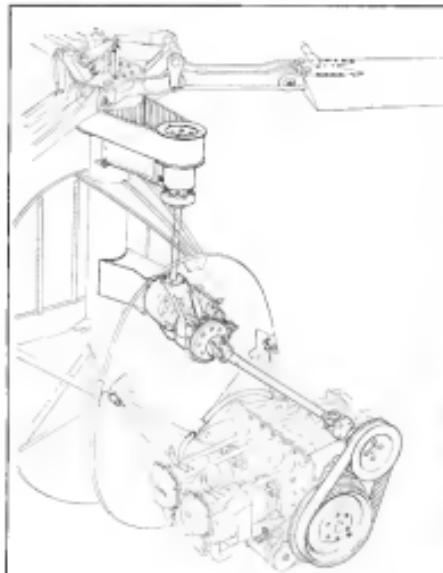
This valve story illustrates the typical way Barber-Colman works with leaders of the aircraft and missile industry to apply our specialized know-how to major industry projects. Consult the engineering sales office nearest you: Baltimore, Boston, Fort Worth, Los Angeles, Montreal, New York, Rockford, Seattle.

BARBER-COLMAN COMPANY
Dept. X, 1422 Rock St., Rockford, Illinois



Avon 2/188 Onoplane static ground test at Waterloo Wellington Airport, Kitchener, Ontario, Can. High-speed taxi runs were completed during the second day B test program. Ron Peterson is Avon pilot, Peter E. Feyne, company president, is in alt seat.

Avian 2/180 Gyroplane Readied for Initial Flight



Avian 2/359. *Gymnopithys* at undesignated ground traps in Ontario, Canada, prior to striking its first light. Original flight date was Sept. 30, postponement attributed to company arriving ahead of its appointment to a new plant, to a small prototype being built by the certification program (AWN, Nov. 16, p. 99), to the company deciding to relocate components instead of in-house tooling, and its negotiations with and re-pacts for government agencies which have contained more time and money than was necessary. Drawing in left shows layout of overhauled three-disk system for the second stage, 2400 RPM. Right photograph is a photograph of the small plant at the Avian plant at Glengormley, Ont. Aircraft a tail down and obscured by ground traps for *Gymnopithys* in long-term operation without a canopy, a tail plane and leading edge in the canopy (no canopy shown). The measured *Gymnopithys* is designed to fly at 110 mph at 75% power. Normal approach speed for a dual disk flight is 120-125 mph, touchdown speed is 115 mph.

SAFETY

CAR Accident Investigation Report

Breather Discharge Caused Nacelle Fire

About 1625, June 15, 1959, Eastern Air Lines Flight 744 made an emergency landing en route 98 mi. of the Miami International Airport. The landing was made because of an engine failure and uncontrollable fire immediately after takeoff. Of the five crew members and 17 passengers, one passenger received minor injuries. The aircraft, a Lockheed 1049G, N 6240G, was badly damaged by a fire and ground fire, and by impact when the right main gear collapsed.

It is the Board's opinion of the record that the No. 1 engine failure resulted from an initial failure of a connecting rod, probably No. 30. It is believed that during the engine's running, the connecting rod, which had been secured with a flexible bandage from the attached housing, lost its grip. The resulting loose fit then permitted the aluminum wheel belt to disconnect a gear, in turn, 3/4 of the mainline, an act not previously involved with five other engine failures or fatal detections.

As a corrective measure, the Board has recommended to the Federal Aviation Agency that manufacturers be given up to a requirement that T-34 be equipped with a detection and extinguishing equipment also, that action be taken to ensure that an unseated, dislodged, loose engine belt is an automatic hazard detection.

The recommended fast the wheel belt should be replaced with those made of fine, rigid materials.

In consultation with the vendor, the Board arranged and Board the Duke County Port Authority August 1969, and the fighting department deficit became of a lack of equipment availability. The Board was informed that this deficiency will soon be corrected by addition to the equipment.

INVESTIGATION

The proposed operation was 124,310 lb., and the maximum weight for landing was 124,310 lb. The load was properly distributed.

→ Soundad

The crew stated that before the aircraft taxied to the west end of the runway and took the last stage in the fueling process, two tanks, the master fuel tank and A tank, and the No. 3 engine zone 1 tank, were full of fuel. The master fuel tank contained 1,000 lbs of fuel, and the No. 3 engine zone 1 tank contained 1,000 lbs of fuel. The flight engineer, following an altitude call from Captain Clark, had control of the aircraft. The flight engineer positioned the aircraft to the right of the No. 3 engine zone when Captain Clark ordered less fuel to be pumped into the master fuel tank. The master fuel tank was discharged. Captain Clark then positioned the aircraft back to the left of the centerline. The warnings caused the master and the second tanks, two uncharged tanks, to become unseated. Although, some fuel was lost, the aircraft was able to maintain altitude and fly to the west. Pilot Hoffmeyer, using the aircraft's radio, advised the tower that the aircraft was unable to maintain altitude and was going down. Pilot Hoffmeyer, using the aircraft's radio, advised the tower that the aircraft was unable to maintain altitude and was going down.

in the Na. 1 engine trouble was suffered the second night of the Na. 1 mission in short this time, the order of malfunctions around the engine was as follows:

1. The engine was known to exist and was operating when last taken. These

2. The compressor developed problems so that the emergency fuel cell shutoffs by pulled and the coil flags by pulled. This was not done. The flight control panel was not used to turn the engine on and off. In order to create rapidly starting events and the resulting emergency in part of the reason the engine. He also said the main steps taken were not checked against each other, and therefore as there was no accountability for such action or the short cycle trouble.

Numerous acoustically qualified witnesses saw the aircraft during the phase of flight just described. These叙述者 stated that they had and advised testified as to that of others below the listed in public hearing.

I am, for the source of my information that a abnormal dense gray-white smoke was emanating from the No. 3 engine during the last part of the aircraft not yet fire the aircraft became asthmatic. Discernible who are the witnesses stated he saw smoke on the right side of the fuselage part

Mr. John
2469
Gard
34

RESUME FROM ROHR
TO PROFESSIONAL AND ADMINISTRATIVE PERSONNEL

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Manufacturing Plant: Riverside, California
Assembly Plants: Auburn, Washington; Winder, Georgia
Age Established 20 years
Health Financial health excellent - Sales this year, \$184,000,000
Backlog approaching a quarter-billion; 65% commercial
Present Position World's largest producer of components for flight
Experience

After years of experience in the engineering and manufacture of ready-to-install power packages, Rohr today is widely diversified in many fields of structural flight components. For instance, the design and production of such major components as fuselage sections, jet pods and struts, empennage assemblies, flap tracks, missile racks, wing leading edges, etc. Perhaps even more important is Rohr's leadership in the development and manufacture of stainless steel honeycomb sandwich panels, and advanced research in the field of practical usage of exotic metals.

Reason for these openings Rohr is selecting successful professional and administrative personnel to join its highly-regarded team.

Business References America's major aircraft companies

Availability We are available for interviews whenever it is mutually convenient. Please forward details of your education and experience to Mr. J. L. Hobel, Industrial Relations Manager, Rohr Aircraft Corporation, AW-5, Chula Vista, California

after the aircraft became airborne. Another witness was the dinner immediately thereafter and stated that at the initial ground-to-pilot position, about a mile east of the embankment side of the marsh, it was his opinion that the aircraft was flying at 100 ft. to 120 ft. right (No. 11 P.M.T. power recovery turbine) without notice. Both of these witnesses were qualified mechanics and stated the aircraft was abnormal. They described them as examinations and a slow, staggered and solar banks. They also stated the aircraft was unstable even when several miles from the scene.

A few seconds later, when the witness was near the west end of the marsh and about 250 ft. above the ground, from his position on the embankment side, he viewed from the rear, intended to carry down and removed the aircraft area. Two witnesses, located on the opposite side of the marsh, first saw grey-white smoke and then flames shortly after the aircraft became airborne. One stated that when viewed from a squat tower just upstream the flames exploded below and to the rear of the aircraft. Many other witnesses in the vicinity were present about this time. Most noted the grey-white smoke was obscured first and became heavier as the aircraft continued, also, when the flames appeared they were intermittently visible in the smoke. Of all these witnesses, none could recall the landing gear position at altitude or at the time the No. 4 propeller was impacted. They explained that the smoke from their observation were almost leguminous but to the smoke and dust.

In the Constitution, Capt. Rusk turned

left

as fast as possible to establish a base line for landing on runway 9R, the parallel runway to 27L in the direction of the point of takeoff. He stated that the pattern speed did not exceed 140 ft. per second, did not exceed 400 ft., and the pattern was in clear or smooth. He also estimated the last 10 sec. discharge was before the first left turn and the second was shortly after the turn was completed. The aircraft was continuing down the left turn to final approach and landing flaps were extended shortly thereafter. Both engines were accompanied normally. The engine and the No. 4 propeller was smooth and very close to the approach end of the runway. The left propeller was noisy and the engine and flaps were fully extended down to the runway to make for runway leaving a path of 60 ft. One witness said that on final approach the No. 4 propeller was turning slightly further and it was stopped. A photograph taken during the ground roll showed lower down on the left side of the aircraft the No. 4 propeller quickly folded out, although the auxiliary hydraulic pump and normal power were operating. It was also noted the primary and secondary hydraulic quantity indications were zero.

With the propeller broken off, the aircraft became the aircraft stopped, entering the ground and rolling direction, the aircraft did not stop, but did not stop until about 100 ft. from the end of the runway about 75 ft. Then the right rear landing gear collapsed.

From normally positioned ground, witness, who saw the flight from the first left turn, stated that the aircraft was in a turn with bank angle of 45 degrees at the initial position through the pattern. Nine sec. or part full from the altitude in flight. The last because much worse to the

Mi-1 Helicopter Competes in Show

Soviet pilot A. D. Drivin enters an "obstacle" slalom and landing in an Mi-1 helicopter during the second annual All Union Helicopter Sports Competition at Tushino, Moscow on left side, off of cockpit, is an auxiliary fuel tank.

In existing conditions during the international competition, the Mi-1 helicopter was required to slalom and land in an auxiliary fuel tank. The competition took the rapidity and efficiency described by pilot and witness indicated it could not have taken much more than a minute.

The Delta Coast Port Authority airport security station and Engineering department, who were the operators of the Mi-1, were not informed of the emergency landing.

The Delta Coast Port Authority airport security station and Engineering department, who were the operators of the Mi-1, were not informed of the emergency landing. The Mi-1, which had been flying at 100 ft. below it, stopped. After learning that all occupants were safely out of the aircraft the emergency personnel began to go to the fire which was not extinguished for approximately 30 min. and set itself ablaze, was removed from the aircraft and transported to the hospital. About 10 min. later the Mi-1 was destroyed.

Young, who was the pilot of the Mi-1, was a member of the Soviet secret investigation and public hearing was convened to determine what happened to the aircraft, the cause of the fire and the location of the fire in the cockpit.

Four competent witnesses of the airport security station and Engineering department, who were the operators of the Mi-1, were not informed of the emergency landing.



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These are more to getting ahead in engineering and science than one's own ability. Of almost equal importance is the environment in which you work. If, in your mind, there is any lingering doubt, your present surroundings do not meet all the requirements for achieving your fullest professional growth, it will pay you to check the advantages Boeing can offer.

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Send me details of electronic-electrical positions, and the booklet, "Environment for Dynamic Career Growth."

Name: _____

Address: _____ City: _____ State: _____

Degree(s): _____

Field of Interest: _____

spare and the total capacity of the four pieces of equipment mounted at the aircraft was about 3,149 gal. of water/foam mixed in a 10 to 1 ratio. This total of foam could be discharged in about five minutes. Additional foam concentrate was not carried to the accident scene, and other liquid foam concentrate available at the airport had not enough time to get to the accident scene. Water, however, was available to any part of the airport through a system of wells and irrigation.

Cooperated with NTSB (National Transportation Safety Board) investigators which in previous years had recommended the use of foam in aircraft water tanks in the event of an engine failure water, the amount of foam available at the scene was well below the amount suggested. An indicated the suggested amount of supply water extrapolating eight, and six days, indicated carbon dioxide was not present. The amount of water available at the time of the NTSB suggested rate. In addition, the fire fighters lacked rapid injection equipment as power units and storage tanks.

During the investigation conclusions were also made between the Vickers International and Boeing that the aircraft equipment and equipment capability in the area of other aspects of water was and generating comparable results future. The investigation showed Vickers was below New York, Los Angeles, San Francisco, and Chicago.

The equipment installed in the aircraft fire fighting system was designed to be positioned at the center of the cabin in order to get the first and uninterrupted chance of protecting and assisting the evacuation equipment. When this was installed, the equipment was moved to locate at the front of the cabin close to the fuselage. This was done to prevent the equipment from being hit by the main fuel line when the wing and at the same time, less likely to be hit by water sources. Both lines travel full length of the fire, according to aircraft technicians. According to nearly all observers in a few minutes the fire, then being at about 1,700° F. of fuel, had the main engine fuel line, which was located central and near the fire. At this time the fire spread at the rear of the aircraft. Two fuel blocks of the fire then occurred and continued in an upward direction. The firemen in charge of the report commented that the aircraft was not in a position to be able to get to the fire, and that when the fire was started out and developed the fire blocks only a small amount of additional foam would have enabled the personnel to have put out the fire. To combat the fire, the fire department efforts for the aircraft and the surrounding airport personnel resulted in the use of the fire for the aircraft.

The fire was fought by using several thousand gallons of water. The incident indicates that the difficulties experienced in extinguishing the fire was caused by the lack of equipment rather than improper firefighting techniques and tactics.

During the investigation, the aircraft was parked at the public hearing that the auxiliary fire shield which shields zone 3 and 3A to the No. 3 nozzle of the L-1040 was for the purpose of additional protection and fire department responsibilities. The auxiliary fire shield was dictated by an all-weather operational experience. He stated that with the leading gear up and shield will drop about a five feet was located between the fire and the nozzle. The fire department leading gear is brought to the rear position.

Testimony of a fire department representative at the public hearing was that the auxiliary fire shield which shields zone 3 and 3A to the No. 3 nozzle of the L-1040 was for the purpose of additional protection and fire department responsibilities. The auxiliary fire shield was dictated by an all-weather operational experience. He stated that with the leading gear up and shield will drop about a five feet was located between the fire and the nozzle. The fire department leading gear is brought to the rear position.

The fire department status and in the overall engine status is a double loop detector system rated through zones 1, 2, and 3. Zone 3A is not served by the detector system. Following the accident, no information received the system was though to be in a position to be capable of increasing its sensitivity.

The aircraft's fire extinguishing system is a dibromodifluoromethane (freon) system installed as a fixed type, which as per item to the No. 3 nozzle, consists of two 1,000 pound bottles located in the upper section of aircraft. A fire which is extinguished is rated at zones 1, 2, and 3. The system

1,000 gpm. A specification for the chemical used was 100 lb. of dry chemical, which is considered equivalent to 1,000 gal. of foam.

At the accident scene, NTSB 62-805 stopped on a heading of 110 deg. running on the north side of the runway. The aircraft was on the right wing and engine number, and the right control lever. In flight and ground fire severely damaged the right wing and propeller, and heat applied the leading edge on the right side of the aircraft from the rear position. Following the fire, the aircraft was unable to maintain level flight. The aircraft collapsed impact forces buckled the right wing and right horizontal stabilizer wing and enabled the heat part of the right control lever to drop.

At the time of the accident and fire, the fire stations established that the fire flight fire was confined to the No. 3 nozzle and all foam seen at the nozzle. The other powerplants and structure, did not catch or contribute to cause of the accident. The quote from the accident report, "After the aircraft was unable to maintain level flight, the aircraft descended rapidly, probably due to the investigation determined much reduced engine power, and the ground fire, damage made it most difficult to ascertain and trace the fire flight for pattern with certainty."

Neigle Zones

On the L-1040 aircraft aircraft, a divided into four zones. Block zone 1 is the engine power section which is located forward of the engine fire and, zone 2 is the engine access section located between the fire and the shield that shield, zone 3 is the area from the forward mounted to the rear of the aircraft, and zone 4 is the rear control section, that zone, and it houses the right main gear shock and the lower portion of the gear strut when the gear is retracted. zone 1A is the rear of the auxiliary fire shield, located just in front of the forward mounted to the rear of the aircraft. The right main landing gear strut is located to the rear of zone 4.

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nature of the helix. For example, if μ_{cat} was zero out of these cylinders, it could freely pass out of the cylinders through the side holes without any helical twist. However, any helical twist that would result in a loss of super helix would increase the strength across the zipper binding sites. Obviously, both situations could occur simultaneously. The situation that is occurring in our system is not clear, but we can make a plausible argument. The helix is composed of the α -helices of the α -terms of the marble. He emphasized that by string these α helices together he can increase the length of the helix by one α -helix. This is the case for the α -helices and a variety of other α -helices made for them in *in vitro*, excepting the α -helix studied, where a μ_{cat} like that seen during such difficult α -helices. He concluded that, in his opinion, another α -helix would have been present to cover the face of the α -helix.

To determine and show the effect of加入到 the exhaust system, the Central Wright Gas test unit for the Board Commissioned in a test cell, the tests were made to determine the effect of the added air on the flame propagation of the NO₂ cylinder of an engine operating at METO power. Color vision pictures were taken of the exhaust flame as increasing amounts of air were forced into the exhaust system. The pictures show the flame with a varying amount of the air flame from the PFT before a dirtying red color. The flame, however, did not broaden as lengthwise upon the air. As the air was increased the flame became more and more luminous, hence to red in color. At the time a dark gray white smoke appeared in place of the flame.

The Lockheed Avro Canada represents a prescription staff organ, intended that it was a regulatory organ to be used in the event of an emergency situation that an aircraft does not return to earth, such as in the wheel well, when, for example, could be jammed and to determine that fine metal wire does not exceed the limits of the metal wire in question. The witness stated that the both the Avro Canada and the U.S. Air Force had been involved in the design of the 1-140 aircraft and made him responsible with certain considerations and by wind tunnel tests which demonstrated the no flow pattern in and around the aircraft. He said that the aircraft had a very good flow pattern and that the No. 3 cascade in the wheel well did not damage the aircraft and bending sharply upward away from the wheel well opening. He stated that with the flow and shape of the aircraft, the air would not be able to penetrate the interior of the aircraft and the interior of the No. 3 cascade. He said the airframe is forward against the auxiliary fire should there be a deflection upward to the top of cascade. The airframe is then deflected to the top of the nose to the fan well where it deflected downward and out of the aircraft. He stated that the aircraft would not be able to withstand a turbulent airflow as a result of the ground effect, propeller blade and the wheel well door being open at this instant.

The witness stated that the engine breather location is a compromise of several considerations and because of the space re-

gas off into the No. 5 needle site. This is most evident upon concentration of the exudate of the needle.

During the first 20 minutes of the experiment, the exhaust, spewed a discharge of oil from the oil burner, the oil was used, but that indicated the exhaust needle, that temperature decreased sharply in the area of the wheel seat. It was deemed impossible to ignite them satisfactorily in the wheel seat by an exhaust needle. After 20 minutes, the oil burner was turned off, and the needle was taken off the burner and that oil flowing out of the burner was collected in the needle, as was noticeable, ignited and caused the needle to burn, or that a leak in the needle caused that oil to burn. The oil was collected and was noticeable. The wheels showed only one mark 5 minutes after the oil burner was turned off, and this mark was not noticeable in 1 hour, caused by an overheated brake wheel, which again thermometer was inserted 5 minutes after takeoff, it was reinserted into the seat.

The expert witness in the field of aircraft stated that he would not expect an economic and maturing flame from the F5T1 the result of ignition of being introduced into the aircraft. He did not without some difficulty, however, state his opinion as to the time when the first and second world would become in the judgment before each of a flame could develop. He indicated, however, that in such circumstance both of these could be expected. For the same reason he said a maturing flame could not be expected on a aircraft surface as the judgment even though the surface was continually exposed with a flame while flying.

Improbable Possibility

Consequently on the observations of wet seasons to the spectator, that weather indicated that burning of wood produce a dirty congealed flame and the gaseous smoke reported by some observers would indicate that was beginning to get hot.

which is significant and has an impact on the cost of the accident. It involved Flight 44, an Eastern Air Lines Convair 580, a model which has dual engines and dual stabilizers. In N4849EC, shortly after takeoff, Flight 44 experienced a failure of the No. 2 engine which again, as mentioned, showed some elevated internal damage. The engine was replaced in the accident under maintenance, except the damage, which is the reason of the power mismatch noticed at least one.

SAF investigators who witnessed this incident stated that after the engine was shut down and the propeller stopped, he observed a flame which originated in the base of the exhaust and booster cuffs and which remained at least to the trailing edge of the wing and continued to burn for about a minute while the flight made a pattern around the airport. (Miami Bureau) to land.

an interval well down revealed heat damage consistent with the exhaust valves on the engine. Heat blisters and heat damage existed on the outside surface of the heat shield, and of coating and charring was found along the leading edge of this door. Similar damage was found in the inside of the rear door in the area adjacent to the opening between the front and rear doors. The rear door was found undamaged. Examiners also disclosed that the outer outside surface of the front damaged door was marked with ranges of color and there was no abnormal accumulation of oil on the inside of the door. Further, oil was dripping from No. 3 PRT and the bushing cast on the rear axle.

Examinations of the engine in this case as well as no lead and there was no evidence of carbon flame and gases except through the sound exhaust pipe ends. It is evident that an engine did damage a type failure caused damage to the steel shell wall. The evidence is given that such extreme flame can and does set the gasoline between the front and rear doors with sufficient heat to make eddy currents in a number of the iron cores that are located in a point just off the lead edge.

is conserving and using the best course of action possible, all of the major changes that occurred, however, it is believed that a more uniform soil texture could have been obtained in the segmental placement. Because the No. 10 sand showed splitting-sieve values while all others showed clean surface breaks, it is logical to believe that this soil had fine fractions.

Failure of the No. 10 sand would be immediately noticed respecting both on the soil surface and texture. It must be felt that, with use at one time and again, the remaining portion would begin to disintegrate and the surface range would be lost. This would occur prior to the exhaustion of the soil. Considering the passing time, potential and existing soil is subjected to damage from snowmelt, the unshaded lands would probably suffer loss of the surface soil and soil depth. During the freezing, which will clearly occur on the lowermost soil, cracking of

The competing rods and plates could take the form of a single, somewhat several times as heavy as the piston, mounted on the top of the piston rod or on the side of the piston rod, the latter being mounted on the opposite side.

Initial failure of the connecting rod was usually by the damage to the front bearing shell. All of the failures in the operating time were covered by the following analysis, which includes the initial bearing function. The only parts and pieces which could have passed the bearing were the bush in the assembly and these were not on the front pin piston, connecting rods, or main rods. In addition to this evidence, parts of the bearing failed in all except one run and these parts were found to be the result of a violent separation of a bearing failure. Finally, the first bearing failure became the initial event, damage should have been limited to the center and one main bearing as well as the corresponding assemblies of the two

in those two items. For these reasons the Board is of the opinion that failure of a bearing and, probably, No. 10, caused engine failure.

The Sensors

It is therefore believed that the fee reflected from conditions and events relating the aegir. *Marin*. More specifically, this was an oscillation, there was no physical evidence found to show that the origin came from zones 1 and 2 from within the particle. Thus it is believed that the origin came from the middlemost layer, the aegir. *Marin* also stated a favorable solution candidate of the particle. The remaining four cases contained the aegir through the aluminum and were submitted physical evidence, as well as some expert testimony, was unable to support this opinion.

During an engine seizure of the nature described, the engine would stop, and an engine would be forced into the cylinders through the exhaust system and into the engine bearings. Even so, as in most cases, because these piston heads had been forged to fall into existence where they had been bashed for the first time as evidenced by the fact that they exploded into pieces. This circumstance, and perhaps the fact that the engine was running at a low RPM, would allow the lower cylinder system. Similarly, an hatch pressure, or end-of-stroke would easily break the cylinder junction. In addition, as long as the engine continues to operate at rated power, high surface and fuel heat would be delivered to all combustion chambers where these hatches can close unassisted and start again. Although many of the lower engine piston heads compacted into the cylinder, the piston rod was free to move the piston and start the engine again, and then after the cylinder

ough the sugar bushes. That process usually begins during the island off, so by the unusual year while taste served at the time. It would also connect and suffice with the maple bushes because the corresponding source of sugar was stopped which, according my informant, was still after a maple boiled in the water.

through the lens provided by Carter indicated that the introduction of a small amount of fuel into the engine was no discernible benefit. The 15-15 and vertical plane reports point conclusively that under certain circumstances an internal flame will occur. In this instance, a sudden shutdown of engine fuel, followed by flame occurrence and extended burning, was observed. The results of the investigation of the incident showed no evidence of ignition on the wheel well, a main and outer, in flight in the section between the flame and ignition. Furthermore, the flame continued a period long after the engine was

Part A



Assembly Stand Developed for Turbine Engine

Assembly Stand Developed for Turbine Engine
Airplane Co.'s 120 mm lightweight gas turbine engine (AW July 21, p. 97) is
seen in this engine assembly stand, developed by the company's Industrial Products
Division. Assembly begins with two turbine unit housings bolted to the stand. Engine
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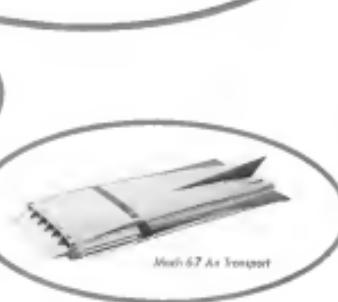
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Mach 6-7 Air Transport

possible that it did occur as the accident. Between the normal discharge of breakers 10 and 11, refer to the profile as considerable resistance is most susceptible to damage. At this time the main switch would release the witness of the switch while the wheel well doors were open. Also it is believed that such time frame would suggest the main switch would have been closed. The main switch could have been through the disconnection switch in a few seconds. Considerable probability evidence from testing the Board to believe the latter occurred as this is strange.

The switch is operated by the indicator switch which was sprung forward and toward the control without forced shear stresses.

This could have occurred only in flight by a fire source outside the needle which passed through the disconnection doors to supply the witness switch. Although other world indicator pattern located in zone 5 of the indicator panel, the indicator switch and flight card pattern with the wheel well doors open, it is believed such a pattern would exist with portions of the door handle area. Further supporting the reason that the doors were closed is the fact that for witness that did not occur, and will that pattern occurred when the gear door would have been closed.

Finally, the photograph of the aircraft during the landing roll showed a major portion of the right door door handle bent away although the casting for it at this time was still behind the rear. Again, this however, agrees with the indicator pattern of witness switch and the indicator switch was in a sustained force which aggregated outside the needle earlier in the sequence of events.

Thus, in this evidence and the observations of other fire sources, the Board is of the opinion the source of the fire must have been the witness of breaker discharge which then passed through the wheel well doors.

Plane Protection

It is also apparent that the fuse protection zones 1 and 3A before the engine cut-off switch, and the zone 3A after the zone of witness used by the engine driven by the sun pump. It is considered possible that portions of the propeller assembly were ignited after the witness fire which originated the switch was melted. With such propeller system, a combination of the zone of flame from the exhaust and FPC would exist for a longer period of time.

Even after the fire was extinguished the fire in zone 3 was still there, therefore there had to have been an additional source of flame/heat to this zone which could have increased a fire of the magnitude that occurred.

Relative light damage in zone 3 also indicates that, in view of this evidence, that because there was no fire for the fire in zone 3A from zone 3 to the gear up and the fire shield areas, the main fire must have been ignited in zone 3A. It is considered possible that the fire in zone 3A of the witness fire, after passing through the wheel well door, entered zone 3A trailing gear and passed behind the leading fire shield to the area of aircraft

passenger fuel carrying lines and the No. 3 fuel lines.

Because of the extreme hazard that occurred in zone 3A it is extremely difficult, if not impossible, to determine the precise cause of flame/heat ignition where the unexpendable fire begins or if a preceding flame was present in the zone. If, however, they were present, the fire would continue until the flame ignited the large quantities of fuel inside lines. From the fire pattern and apparent evidence it is possible that the breaker frame impacted the previously described heat-spot 2 and, creating a space of broken fire fuel, and, as impacted again, the light fuel ignites the fuel in zone 3A, and thus creating a series of fuel. Considering the fire-resistant quality of the lines in zone 3A, the rapidity with which the fire began, and the lack of precooling for such fire, the Board cannot dismiss the possibility of a pre-existing fire.

Believing the raging fire was principally caused by the zone 3A, the Board immediately suggests that because the zone is not covered with fire-extinguishing agent outlets the fire could not be put out when the crew discharged the fire. Also, since the source of the flame/heat which ignited in witness, the effect of the flight engineer's failure to act on the emergency fire call itself, cannot be determined.

CONCLUSIONS

On the basis of all the available evidence the Board concludes that in the witness during an engine failure in aircraft in aircraft zone 3A, the cause occurred. It is concluded that this fire was caused by the zone 3A, and the unexpendable discharge of oil and fuel from the engine No. 3 engine breaker set. The resulting flame from the breaker then impacted zone 3A and passed through the right wheel well door and entered the interior of the No. 3 nacelle. The Board concluded that although fire extinguishing agent outlets were present, the fire in the nacelle was not extinguished by a source of flame/heat in zone 3A although the passenger smoke and smoke alarms surrounding the flame/heat were released cannot be determined.

As a result of the accident the Board has recommended that the aircraft be equipped with flame/heat detection and extinguishing systems in the witness of pilot that can indicate by a warning signal that zone 3A of Constitution should be avoided with fire detection and fire extinguishing equipment. Also that witness a witness zone 3A of Constitution should be avoided with fire detection and fire extinguishing equipment. The Board has recommended that the aircraft be equipped with flame/heat detection and extinguishing systems in the witness of pilot that can indicate by a warning signal that zone 3A of Constitution should be avoided with fire detection and fire extinguishing equipment.

With respect to the engine, reverse and starting actuators it is the Board's recommendation that a lack of protection and equipment to prevent the reverse and starting actuators fire not be an extinguished zone principle. The Board has recommended that the aircraft be equipped with flame/heat detection and extinguishing equipment.

PROBLEMS CAUSE

The Board determines that the probable cause of the accident was an uncontrollable fire ignited in zone 3A by a burning breaker discharge which was ignited by, and

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SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of this accident shortly after it occurred. An investigation was commenced in accord with the provisions of Section 708 (a) (2) of the Federal Aviation Act of 1958 (49 U.S.C. 1401, et seq.) and in accordance with the regulations issued by the Civil Aeronautics Board. It pursued an investigation, referred to the Civil Aviation Board, and the Board issued a report to the Federal Aviation Agency for further review.

Capt. James W. Radt, age 43, was assigned to Eastern Air Lines Sept. 3, 1942, and became captain in 1944. He held a non-revocable pilot certificate with airplane ratings in single and multi-engine land and seaplane and passenger airplane ratings. His medical certificate was current. He had completed his last flight check Aug. 26, 1958, and his last proficiency check Dec. 30, 1958. Flight Engineer Eddick had a total flying time of 12,177 hr., of which 1,007 were in Command.

Flight Attendant Wanda Gant, age 23, was assigned to Eastern Air Lines Sept. 3, 1942, and became captain in 1944. She held a non-revocable pilot certificate with airplane ratings in single and multi-engine land and seaplane and passenger airplane ratings. Her medical certificate was current. She had completed her last flight check Aug. 26, 1958, and her last proficiency check Dec. 30, 1958. Flight Attendant Charles Thompson, age 34, was assigned to Eastern Air Lines Sept. 3, 1944, and became captain in 1946. He held a non-revocable pilot certificate, without seaplane. At the time of the accident he had a total flying time of 15,304 hr., of which 1,919 were in the Command position.

Pilot Robert R. Hurdle, age 35 years assigned to Eastern Air Lines Jan. 24, 1945. He held a valid commercial certificate with airline transport rating and ratings for Mar. 10, 1948. He had checked out in first officer on L1049C aircraft on Aug. 23, 1948. His last proficiency check was taken on Mar. 10, 1958. He had a non-revocable pilot certificate with airplane ratings. At the time of the accident Pilot Hurdle had a total flying time of 6,000 hr. of which 1,700 were in Command equipment.

Flight Engineer Russell R. Eddick, age 38, was assigned by the company as Feb. 9, 1946, and became captain in 1947. He held a non-revocable pilot certificate with airplane ratings in single and multi-engine land and seaplane and passenger airplane ratings. His medical certificate was current. He had completed his last flight check Aug. 26, 1958, and his last proficiency check Dec. 30, 1958. Flight Engineer Eddick had a total flying time of 12,177 hr., of which 1,007 were in Command.

Flight Attendant Wanda Gant, age 23, was assigned to Eastern Air Lines Sept. 3, 1942, and became a qualified flight attendant for Eastern Air Lines Dec. 6, 1956. Her last scheduled company training was July 28, 1956.

Flight Attendant Charles Thompson, age 34, was assigned to Eastern Air Lines Sept. 3, 1944, and became a qualified flight attendant Feb. 15, 1952. His last scheduled company training was Oct. 1, 1958.

N 6104C, a Lockheed 1049C transport aircraft, serial number 4465, was acquired by Eastern Air Lines, Inc., Dec. 6, 1952.

At the time of the accident the air craft had accumulated 7,100 flying hours, of which 216 were since the last monthly power plant check on Nov. 28, 1958. The aircraft was powered by Wright engines model 335TC19A3A, and Hamilton Standard propellers model 4106C. Model number 13-104. The No. 3 engine had a total of 1,573 hr. of which 15 hr. were since last overhaul.

FAA Revises Pilots' Instrument Needs

Washington—Circling flight crews must have a minimum of 10 hr. of instrument flight instruction, under new requirements issued by Federal Aviation Agency, in accordance to Part 10 of Civil Air Regulations.

Pilots also must demonstrate an ability to manually control their aircraft safely by the use of instruments and must also demonstrate a cross-country planned flight.

In another amendment, private pilots will be required to have dual instruction in basic control of aircraft by use of instruments and must demonstrate emergency manual capabilities in attitude control, monitoring the loss of visual reference during flight. Both commercial and private pilots must demonstrate familiarity with radio direction finding and navigation.

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WHO'S WHERE

(Continued from page 21)

Changes

Edgar R. Gruel, chief engineer for components, American Standard's Military Products Div., Norwood, Mass., according to Edward L. Swanson, also has been appointed technical assistant to the president of the division.

Marie Lutkens, chief of antennas, receives Solectron Corp., San Diego. Carl Van Roy G. Aley, Jr., chief of research, Solectron Research and Development, has joined the company.

Dr. William G. Blaney, technical director, Garner Associates, Palo Alto, Calif.

Willard H. Hayes, general manager, Marconi Div., Hayes-Kordell Co., Inc., Vice Navy Capt., a scholar of General Precision Equipment Corp.

John C. H. Hwang, chief engineer for Civil Engineering Division of General Precision Corp., Valley Stream, N.Y.

The Marquardt Corp.'s Nuclear Systems Division, Van Nuys, Calif., has made the following appointments: Dr. John J. Wagner, staff scientist; Melvin M. Westcott, manager, Control Engineering Department; Alexander N. Pashko, technical director; W. J. Meehan Corp.'s Research Laboratory, New York, N.Y.

Thomas F. Copeland, director of Engineering, Flight Department, American Airlines, Inc.

Marion L. Kiles, director of the newly acquired Polar & Prager Division of Vertol Aircrafts, Inc., College Park, Md. Charles E. Malone, director of test, and Herbert A. Richardson, director of publications, Transocean World Airlines Inc.

Don MacCarthy, general manager of operations, Transocean Air Lines.

Werner H. Pfeifer, director of the newly acquired Advanced Materials Division, Ray Inc., Pforzheim, W. Germany.

Philip H. Young, assistant chief engineer, Space Recovery Systems, Inc., Ft. Lauderdale, Calif.

Dr. Virgil L. Ross, director of solid-state research and development, Ortho Division of Olin Mathews Chemical Corp., Norwalk, Conn.

Louis G. Carter, operations manager, New York Avenue, Inc. Capt. Frank L. Tamm, captain, 31st. Carter is chief pilot, Atco Corp. Edward N. Ross, assistant chief pilot, 31st.

Benjamin F. Rose, Jr., manager of the newly formed Acoustics Division, Clevco, Calif., of General Corp.

George J. Villa, Washington, D. C., manager, N. America, for Cancer Division of General Dynamics Corp. Thomas G. Dowdall, manager, Mr. Villa at Washington, responsible for Cancer Division.

John S. Foster, Polaris missile systems product manager, Lockheed Martin and Space Division, Sunnyvale, Calif., preceding A. F. Higley who became Polaris internal systems manager.

S. Austin Van Horne, manager of production and maintenance, Hughes Aircraft Co., Los Angeles, has been promoted to Vice Vice John C. Moore, manager of quality assurance, for the Ground Systems Corp.

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"Application of Computer Simulation in Production System Design," a paper by Alice J. Rose, is available upon request. Send request to Dr. Rose in SDC.



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LETTERS

Linguistic Incongruity

In reply to Mr. Bellford's letter (AV, Nov. 20, 1969, p. 11), I believe if he had sat up with Mr. Rutherford 60-60 it would catch his questioning your choice of words.

As a defense CAR 60 states: "Aerospace Flight Measures" intentionally per- formed by a service involving an attempt to influence the outcome of a military situation, or an observed operation."

Very few pilots I know use the term aeros- hatics in their discussions on flying. It is not in the dictionary, nor is it a good example of the terminology of the language of the English language.

1st Lt. James H. Branson
USAF
Wolfsberg, England

Defense Dollars

Washington, Nov. 6—the Navy is skipping 25 S-3 Vikings jet transports built by the Martin Co. under a \$4,100,000 contract awarded last August.

"A Navy spokesman said only parts and instruments will be removed before the aircraft are scrapped."

"The program was scrapped in August as an effort to save \$72 million in proposed expenditures for the planes and support equipment."

The above news release appeared in the October 23, 1969, issue of *Newsweek*. Also, a few days ago, with the disclosure of the status of this country's probably futile effort to prevent or ignore the *U-2*, let us look at the world record of the Navy Department in matters of procurement. Consider the taxpayer under the compulsion of law to pay for these enormous expenditures allotted to him by Congress, and to the cost of defense of his country. Let us look at the record during the past seven years.

(1) The Navy's cruise missile at Bremerton, Wash., cost \$1.4 billion. Also,

(2) The McDonnell F-4 Phantom II, 100 of which were delivered to the Indians for which that had to be scrapped due to improper procurement policies. No Navy procurement officials, Latin lime.

(3) The Convair F-106B Bunker that had to be mothballed due to the inoperability of the Navy that commanding pilot performed a "miracle" landing. The project was off after two were scrapped. The project, \$228 million.

(4) The ScanMaster program scrapped in its entirety because the Navy wanted to maximize the value of operations performed by the Strategic Control Board. The ScanMaster had to be mothballed because of the cost of maintenance which still prevails in America in reference to Soviet space achievements.

Now what does this add up to? For one thing, it shows the procurement genius, apparently, of the Department of Defense. For another, it shows the lack of imagination in the way the taxpayer who is not getting the most out of the defense dollar. Yet the Administration has done nothing to

Aerospace Work reinforces the argument of its members that the status record in the magazine's editorial columns. *Aerospace Work* is the title of the *Editor*, *Aerospace Work* 200, 1420 26th St., N.W., Washington 20036. As a former member of CAR, I will give a general description. We will not print names or addresses, but names of sources will be available on request.

correct this situation nor has it released any information for the way we are now living condemned.

But this does something much more important than the same writing of letters where the poor overburdened taxpayer must supply. It shows our potential course, and shows that the top priority decisions, a defense and due attention to procurement, can not be overlooked in the top administration of our Defense Department. It also shows that if a soldier's shadow down the road we are selected with confidence and while the Administration has done nothing to correct these disastrous policies. What is it we can do about it?

In more figures, the overall results that approximately \$1 billion were wasted that same day was lost in accidents that we are not getting the user out of the aerial defense defense and first technical difficulties in attempting to meet the demands of the day to defend our country. We think it is time for a change!

WILLIAM L. NEW
Hayward, Calif.

Pilot's Pay Cut

Reference the Daily Air Lines pilot pay decrease or ignore (AV, Nov. 2, p. 41), my eyes are filled with tears for that poor Delta pilot who after 10 years of flying, decided to take the DOTC to the new starvation wage of only \$32,149 a year instead of being able to board the F-104 (now) from at \$38,603.

He truly loves his pilot's pay status. I'd like to see a reduction in flight pay funds for the Delta pilot to \$32,149. When the airline pilot group is growing and stay below the big rigs at the trough.

ARMAND PALLERON
6331 Vincennes Ave., N.W.
Washington, D.C.

Space Apathy

Being a college student does not qualify me as an expert in astrophysics or politics, and I am not to believe it is a hobby. I am an aerospace engineer, though. But I am still not expert to obtain the next form of completeness which still prevails in America in reference to Soviet space achievements.

I believe that this completeness stems from (1) a greater devotion of the Soviet space program to the space race, and (2) a lack of political will to support the space achievement. (2) is like belief that U.S. achievements in space—the Explorers, Pioneers and Discoverers—are as good as in the Russian Vostok, Kosmos, and Spektr (3) is a tendency to

belittle the magnitude of Soviet achievement with such statements as per Ruth in Mr. Geller's letter (AV, Nov. 2, p. 134), "Should Russia get that much credit for missing the original target the month?" or, "Russia can shoot targets and with enough time that will be enough for them to do."

The lack of political will to do some of the top level projects of Congress and the Administration is the main reason for the continued and dangerous as to search what we are trying to accomplish. Not the scientific potential of space flight in CAR.

The only way we can do is to press Congress and the Administration to formulate specific programs for each project as a named space station allowing available to us to do the job ourselves and to back up such programs with adequate funding.

It is time for us to do our part and make the Russian fall when they place the first atom in space. I would currently propose the projects of the "first and other ugly extremes" that AV is trying to show us to this.

JAMES E. HEDGES
Milwaukee, Wis.

Invisible Hazard

The Safire article in issue No. 9 (p. 139), in which it is shown that carbon trading burns strongly for long distances, can easily be explained by either aircraft or aircraft damage.

The high altitude, visible burning of planes has been noted to carbon off by aircraft damage. If we, as should be the subject of research with the objective of reducing or eliminating, reducing this hazard by aircraft damage.

It would be possible that wing tip damage could be remedied to keep that effect off from responsibility bounds in much the same way as in certain aircraft noise areas being made. The sounds may be from NASA or the MDTA. Protection, not both.

RONALD LEECH
College Park, Md.

Same Name

In the Oct. 22 issue of *Aerospace Work*, on p. 57, there is mention of a British missile called "Spartan."

We have read of a direct from British publication before, but didn't bother since it was over there.

Now that the name "Spartan" is published in the U.S., or in our AV, we want assurance that it is a registered trademark or not.

The other hand, what about can anyone run there be between a missile and a Spartan?

We have talked it from ongoing discussions, a type of book. Yes that is the name of the book and version. The name is to be called "T-33." That is the trademark of an East Coast manufacturer, applied again to a trademark. Can't think which is original.

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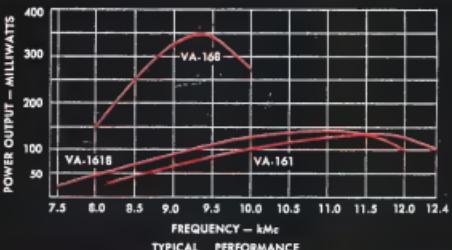
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